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ELECTRONICS TODAY INTERNATIONAL

32 Page Electronic Agencies Catalogue Check Inside

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ELECTRONICS TODAY INTERNATIONAL

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ISSN No. 0013-5216

DOCUMENTATION IS A DIRTY WORD?

BACK BEFORE THE DAYS of electronic chain stores, many electronics enthusiasts (only 'electronics' was hardly mentioned then) cut their teeth on government and military surplus or disposals equipment. While much of this equipment was 'cannibalised' for parts, there were items of useful test equipment and communications gear available that could be pressed into service more or less directly. Manuals for common items of equipment were generally readily available and ordinary operation as well as maintenance or modification was generally aided by the comprehensive details and instructions included. One learned to appreciate the worth of a well-written technical/instruction manual.

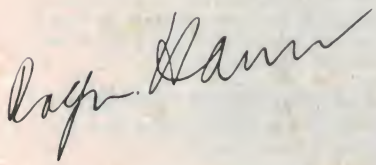
There is a fabulous breadth and variety of electronic equipment available these days to attract the interest of electronics enthusiasts, but with few exceptions, the instruction manuals supplied (let alone technical manuals) fall considerably short of the standard required by users, let alone the standard of the manuals of yesteryear. In fact, some can only be described as ***abysmal***. You've ***actually*** got to figure out for yourself how something works and how to use it because even the basic instructions are so appallingly bad they're confusing at best and downright misleading at worst.

This situation applies to everything from battery chargers and multimeters right through to oscilloscopes and computers. ***Especially*** computers. Manuals for computers aimed at the hobbyist or small business user alike are probably the best examples of useless documentation we have ever seen. Some do not even have clear instructions as to how to turn the machine on!

It seems manuals have been relegated to the status of a 'mere detail', like printing product detail on cartons or the like. From a user's point of view it seems manufacturers consider manuals an unnecessary expense. I rather think that if the effort were put into the production of reasonable manuals, the user would have a completely different attitude to the equipment purchased and to the manufacturer. This would help assure repeat business for further products, and it would certainly help reduce calls for help to retailers and service centres.

FRUSTRATION

Owing to industrial action within the postal service we did not receive the material for the ETI-660 Learners' Microcomputer prior to the deadline for this issue. In fact, the deadline was moved considerably in the hope that it would arrive and a special effort could be made to accommodate it. Alas, even though this was written just as we went to press, the mail situation has not cleared up and we ***still*** do not have the material. May we assure you that our frustration is greater than yours! In publishing, Murphy's law is a square law — if anything can go wrong, your troubles will multiply!



Roger Harrison
Editor

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eti ELECTRONICS TODAY INTERNATIONAL

Video games are all the rage! Our lead story on pages 16-17 explains what it's all about, who and how much money is involved. You'll be staggered. Main picture shows the graphics capability of the Mattel Intellivision system, which employs a 16-bit microprocessor, to be released this month. (Pics courtesy distributor, Lifestyle Electronics).

•

Recommended retail price only.

features

GAME, SET, MATCH 16
The electronic games market is now worth around $2.5 billion and is all set to keep rising — forcing development in other areas such as TV technology. Dennis Lingane takes a look at the industry.

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In this third part of Phil Cohen's series, he explains 'Top-down programming'.

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HOW TO HEX YOUR UK101 99
For those into machine code programming on the UK101, this program will allow you to begin at your start address in memory and look at the next 104 memory locations.

ZX80 RENUMBER PROGRAM 100
A simple renumbering routine that doesn't clog up precious memory space.

LIFE ON A 6800 112
This is an interesting variant on LIFE specifically for 6800 owners. Designed for the SWT range, it should prove adaptable to other 6800-based machines.

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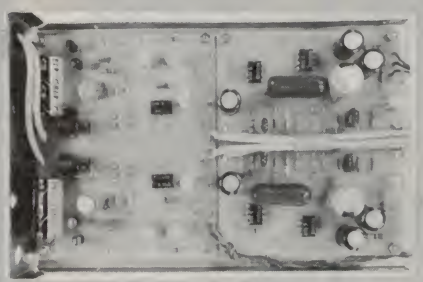

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Dennis Lingane recently visited the Chicago Consumer Electronics Show, and reports that video is definitely what the scene is all about this year.

B&W DM10 SPEAKERS 138
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AUDIO TECHNICA ATH8 HEADPHONES 144
Louis Challis claims that these headphones "offer a rare example of . . . the sort of quality now regarded as the norm from the best loudspeakers . . .".

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SOLDER, SOLDERING AND DESOLDERING
The definitive article on the tools, the techniques and the technology. It takes you from the metallurgy of solders through soldering irons and soldering techniques — including how to identify problems. Desoldering is covered too and a resume of the latest in soldering technology is included. Don't miss this one!

THE HOME COMPUTER
Will computers *really* enter the home? Resoundingly, yes, and not through the 'tradesman's entrance'. Dennis Lingane reports on this fascinating new development that will influence our lifestyle like no other consumer product has before.

ETI-660 LEARNERS' MICRO
STOP PRESS — construction of this low-cost computer featuring sound and colour video in a low-cost design commences in the October issue!

SERIES 5000 PREAMP
Completing the construction of this superb 'no compromise' design. A winner!

ETI-157 CRYSTAL MARKER
A simple but very useful piece of test equipment for calibrating and aligning receivers, transceivers and oscilloscopes. It will deliver frequency 'pips' at intervals of 1 MHz, 100 kHz, 10 kHz, 1 kHz and 100 Hz. The unit is portable and inexpensive to build.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

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SIMUTEK PACKAGE ONE: Five fantastic space fantasy games in one. Outstanding value! X-3685 $29.95.

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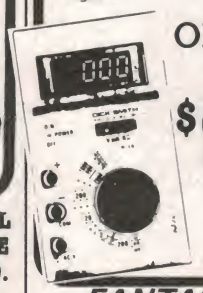

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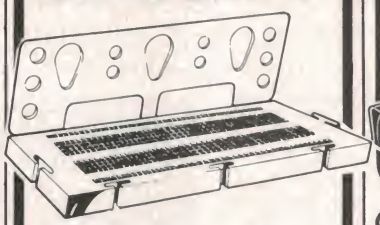

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Consumer electronics — out of control?

Dennis Lingane has just visited (or been overwhelmed by) the US Consumer Electronics Show — the biggest home electronics exhibition in the world. According to him, one thing's now for sure — gone are the days when hi-fi was the bread and butter of the industry.

The CES started 15 years ago basically as a TV exposition, gradually changing over the years to a hi-fi show, which it remained until only a year or so ago. The second personality change basically began last year, when the sudden boom in all aspects of the video market left the audio manufacturers and retailers wondering what had hit them.

Everyone in the industry now seems to be trying to jump on the video bandwagon, and retailers who came to this year's show in Chicago hoping to learn how to cash in on the new technology probably went away with their heads reeling from the plethora of equipment they saw.

What's more, it wasn't the pretty girls and porn queens helping to sell the porn video cassettes who attracted the most attention, though they certainly weren't suffering from any lack of public interest. Many of the audio retailers had come to this year's show to learn about their new livelihood, and trying to catch up on satellite TV, cable TV, home computers, electronic games, calculators, projection TV, as well as video itself, was enough to turn most heads without any help from commercial sex.

US porn queen Kitty Shane sells her wares ... video cassettes.

Audio retailers a couple of years ago had turned their backs on the new video entertainment scene in all its aspects, confident that there would always be an easy living in hi-fi retailing. When the audio market started to slump, these retailers found themselves watching the meteoric rise of those business people who **had** taken video seriously.

Whether the diehards are too late to take advantage of the new industry remains to be seen, but what the CES did force home is that nobody these days can afford to take anything for granted, nor believe that much of the new technology won't catch on.

Two years ago there were no such things as TV satellite earth stations; last year there were three manufacturers exhibiting in Chicago, and they were generally regarded as weirdos. This year **13 manufacturers** of TV satellite earth stations were at the Show, and the leader of them, Third Wave Communications, stressed during a seminar on the industry that they are constantly working on the edge of science fiction.

Sales of colour televisions have jumped 20% in the last 12 months because so much of the new video/computing/electronic games equipment needs a video display screen.

Satellite TV will bring video and the phone to remote users. Old style phone in the foreground shows the march of technology.

There were over 800 exhibitors spread through the three floors of the McCormick Pavilion Convention Centre and in the two hotels used for the Show. Unlike in past years, the emphasis was on business rather than sexy girls and lavish parties; the constantly changing technology and $30 billion annual turnover proved ultimately more attractive than hyped-up revelry to the 60 000 dealers from around the world.

The domestic entertainment industry, which takes around 3.5 cents in the gross national dollar in Australia, seems to be going out of control. If one section of the industry booms, as video has, it draws cash from another section, and so flexibility has become the key to staying in business in the home electronics industry. If you stick to just one aspect, you're like a punter always hoping his horses will come in — and how many gamblers have retired rich?

Dennis Lingane

BWD go north and south

New distributors for the BWD range of instruments have been appointed in Queensland and Tasmania.

L.E. Boughen & Co. are the new Qld agents, located on the corner of Baroona and Milton Roads, Milton 4064. In Hobart, customers should contact D & I Agencies of 6 Barrack St, Hobart 7000.

Contactless ignition

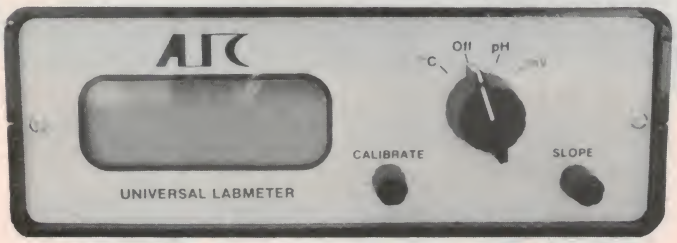
Lucas Industries have now released in Australia their range of contactless electronic ignition systems.

Such is the coverage of the basic unit and small range of fitting kits that they are able to cover 332 models of passenger cars and 120 commercial vehicles, Lucas claim.

By dispensing with the contact set, high speed point bounce, low speed arcing, heel wear and general wear and tear are greatly reduced, resulting in improved high speed performance, improved starting, smoother idling and a steadier take-off, according to Lucas.

Increased dwell angle (the time the coil has to re-energise) is said to improve performance right across the rev range. Because there are no wearing parts the engine stays in tune, there is no timing drift and therefore less fuel wastage.

The kits come complete with detailed, illustrated installation instructions, and cover popular Australian vehicles such as Holden 4, 6, 8; Ford 4, 6, 8; Chrysler, Datsun, Leyland, Toyota, plus English and European vehicles.



pH/temperature labmeter

A combination pH/temperature and millivoltmeter for selective ion measurement of solutions was recently released by the Amalgamated Instrument Co.

The meter will measure temperature from −50 to +150°C with a quoted resolution to 0.1°C and pH with automatic or manual compensation to a quoted accuracy of 0.01 pH. In addition, it will measure millivolts from ion selective electrodes (i.e: fluoride, Redox, Cu ions, etc).

It features a 17.5 mm high liquid crystal display and operates from internal batteries or from ac power. The carry handle doubles as a bench stand.

More details on this and other instruments are available from A.I.C. Pty Ltd, PO Box 134, Terrey Hills NSW 2084. (02)450-2661.

Turin Shroud dated to crucifixion?

The Holy Shroud of Turin, over which controversy has raged as to its authenticity ever since it turned up in Europe in the fourteenth century (see ETI May 1981), recently acquired more evidence pointing to its at least dating from the time of the crucifixion.

An American theologian, the Rev. Francis Filas of Loyola University, subjected the area of the cloth around the eyes of the image to computer analysis, using image analysis equipment at Log E/Interpretations Systems in Overland Park, Kansas. Past analysis had established the presence of coin-identifiable markings on the 'buttons' over the eyes of the figure, but Rev. Filas in this case enlarged the eye sections to produce high-contrast, three-dimensional digitised photos that washed out the weave of the cloth without destroying the pattern.

These images are claimed to have revealed a three-dimensional image of a Roman coin (on the right eye) bearing the representation of an astrologer's staff and the letters 'UCAI'. With the help of a numismatist Filas was able to determine that these letters were an abbreviation for words meaning 'Of Tiberius Caesar', and the coin fitted the description of ones minted by the Romans between 29 AD and 36 AD — around the time of the crucifixion.

The Shroud has undergone quite a few computer analyses before (usually using photographs), and they have never failed to show up surprises. For example, researches in the 1970s and '80s have revealed that the image is superficial and does not penetrate the fibres of the cloth; that there are no traces of pigment; that the linen originates in the Holy Land; that the image contains three-dimensional information, unlike an ordinary photograph or painting; and that the image was most probably not caused by direct contact with a body, but rather — perhaps — by some kind of radiation or force. All these discoveries have if anything added to the mystery of the Shroud; the image and its formation seem stranger and stranger the more we discover about them.


The face on the shroud.

The identification of Roman coins placed over the eyes certainly adds a little more weight to the arguments that the Shroud at least dates from Roman times and is not a mediaeval fake. However, it could also be argued that a forger could have obtained Roman coins in order to add authenticity to his creation — and so the controversy continues.

And for those Christians to whom it matters as part of their faith whether or not the Shroud is genuine, even if it is conclusively dated from the first century AD and the origin of the image determined, the question still remains as to whether the Shroud is actually Christ's burial cloth.


3D image of the face on the shroud showing 'buttons' on the eyes. (JPL pic.)

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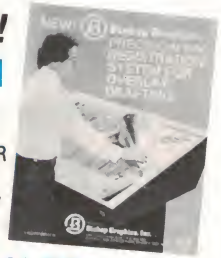

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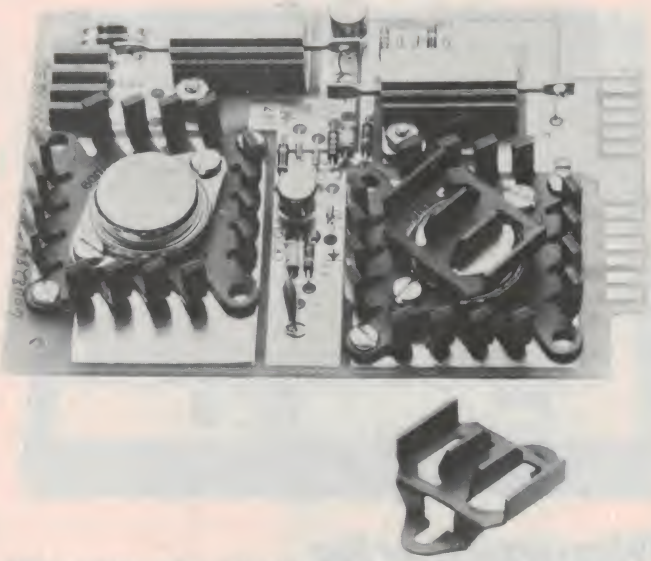
Cure for 'hot spots'

Turning off the sunlamp will cure hot spots — but if you have a hot spot problem with power transistors, a new heatsink from Thermalloy might help!

The 6208B 'top' is a pressed metal, anodised heatsink that mounts on the top of a TO-3 power transistor case, held in place by the transistor's mounting bolts. It can be used as a stand-alone cooler or for supplemental heatsinking.

Thermalloy say the 6208B permits the use of punched-and-pressed board-mounting TO-3 heatsinks when used in conjunction with their device, providing a lower-cost alternative to cast heatsinks for the same application.

The 6208B is quoted as having a thermal .rating of 17.9°C/W. Further details from Soanar Electronics, 30 Lexton Rd, Box Hill 3128 Vic. (03)890-0661.



New Scope agency in Qld

Oliver J. Nilsen (Aust.) Pty Ltd recently purchased the old Scope Laboratories' Queensland agent, K.H. Dore & Sons, and will now represent Scope in that state.

Nilsen Rowe, of 8 Allison St, Mayne Qld, will now handle sales and delivery for Scope in the deep north. In Townsville and Rockhampton the existing offices, now renamed Nilsen Rowe Australia Pty Ltd, will continue to handle Scope products.

Natsemi checks out supermarkets

National Semiconductor is gearing up for a major sales push of its computerised checkout system, Datachecker.

Mr. Ron Hoyt, director of marketing for the Datachecker division of National Semiconductor (Australia) Pty Ltd, said he was projecting sales of $3.5 million in Australia and New Zealand in the next year.

The Datachecker system consists of a laser beam scanner built into the supermarket checkstand and an electronic cash register connected to a computer. Scanning eliminates the need for manually ringing up items, since the scanner reads a special code printed on the grocery products – a code which identifies the item to the computer, where the prices are stored.

Automatic checkout is a three-step sequence. The checkout operator simply sweeps the item over the laser beam built into the checkstand. The laser reads the bar code symbol on the item to identify the product to the computer. When it locates the price, the computer instantly sends it to the terminal.

Within a fraction of a second after the checker scans the item, the price of the product appears on the display for customer viewing and the item name, price and (if applicable) the weight are printed on the register receipt.

Unlike in existing manual systems, the itemised receipt names the items as well as listing prices and a total.

Using the 'MIP' programming language, user programs may be written by store and/or host personnel. 'MIP' is claimed to provide complete flexibility for the user, and execution of the object program can be initiated at the store, by the host or automatically at end-of-day.

Store-to-store communications allow multi-store chains to communicate from, say, a host in Melbourne to a store in Sydney, then from that store in Sydney to relay the data to all other area stores, dramatically reducing line costs.

For further information contact Burson-Marsteller, 19th Floor, 1 York Street, Sydney NSW 2000. (02)241-3016.

Handheld digital thermometers

Two new low-cost handheld digital readout thermometers have recently been released by the Amalgamated Instrument Co.

Both have been locally designed and manufactured and feature battery operation, light weight and 12.5 mm high liquid crystal displays.

Applications include laboratory temperature measurement, internal food product temperature, air conditioning, field service and calibration.

Model SC203 will measure from −50 to +150°C with a quoted accuracy of less than 1°C and resolution of 0.1°C. It employs an IC sensor.

Model TC203 employs a type K thermocouple and will measure from −40 to +1200°C with a resolution of 1°C, according to the specs.

More details from A.I.C. Pty Ltd, PO Box 134, Terrey Hills NSW 2084. (02)450-2661.

Video switcher for security systems

A unit to control complex video-based security systems, employing microprocessor control, has been released by Javelin Electronics, a leading manufacturer of closed circuit video security systems.

Called the Superswitcher, the unit is capable of performing a wide range of switching functions and sequences for 10 to 100 video alarm inputs.

The master control unit features pressure sensitive touch pads and a LED readout of the function or functions selected. A LED warning indicator shows that all cameras are in vertical sync, and an additional LED indicator alerts the operator if an alarm is tripped.

Javelin claim the Superswitcher to be the most versatile video switching system ever developed for this application. Several options are available for the unit that enable purchasers to enhance versatility and increase capacity of the Superswitcher. These options include an Alarm Gather Panel, Remote Transmitter and Receiver. Alarms may be set and reset from the Master Control unit and may also be sequenced or bypassed.

Further details are available from Javelin Electronics (A/Asia) Pty Ltd, 15-19 Boundary St, Rushcutters Bay NSW 2011. (02)33-0966.

In New Zealand, The Electric Construction Company of 39 Nugent St, Auckland were recently appointed agents for Javelin, and can service New Zealand enquiries. They have branches in Wellington, Hamilton and Christchurch.

Giant semis!

Toshiba claim to produce the world's largest semiconductor elements, which they employ in their range of high voltage and high current diodes and thyristors.

Distributed in Australia by Promark Electronics, the range includes rectifier diodes with voltage ratings to 5 kV and current ratings to 3 kA. They also have controlled avalanche rectifiers rated to 3 kV and 50 A.

In the SCR range, Toshiba include devices rated to 3 kV and 3 kA for phase control of mains power. For inverter applications they have devices rated to 4 kV and 400 A. Gate turn-off SCRs are also included in the range, with voltage ratings to 2.5 kV and current ratings to 600 A.

Details and devices from Promark Electronics, Suite 208, 6-8 Clarke St, Crows Nest NSW 2065. (02)439-6571.

Bishop Graphics in the west

Stewart Electronics of Melbourne recently appointed the Perth-based firm of W.J. Moncrieff Pty Ltd as agents for the Bishop Graphics range of drafting aids and materials for Western Australia.

John Day, marketing director of Stewart Electronics, said that this change was made in an effort to improve the service and availability to all Bishop product users in the west. Moncrieff's may be contacted on (09)325-5722 for further details.

Let's hear it for lithium!

A new lithium 'super-battery' claimed to have performance characteristics superior to conventional dry battery systems is now being manufactured and marketed by the Vidor Industrial Dry Batteries Division of Crompton Parkinson Ltd, a Hawker Siddeley company, in the UK.

Compared with other conventional cells, the lithium/sulphur dioxide batteries are said to have the highest operating voltage (2.8 V per cell), the highest energy density (up to 30 times greater than for a carbon/zinc cell), the capability of operating in temperatures from −55°C to +70°C, and a ten-year shelf life.

Marketed under the 'Vidor Eternacell' name, the batteries are very high-energy, non-rechargeable cells designed for use in a wide range of industrial, commercial and high technology equipment, where high reliability, operation at very low temperatures, and high current drain combined with an exceptionally long life are of paramount importance.

These lithium batteries are claimed to have an energy density six times greater than and an operating voltage nearly twice that of their carbon/zinc equivalents. At room temperature and with a one-ampere drain, the energy capability of a single G20 (D-size) Vidor Eternacell is said to be equivalent to over 30 carbon/zinc cells.

Each lithium cell consists of a laminated carbon cathode, lithium foil anode and microporous separator, wound into a spiral core, filled with an organic electrolyte and enclosed in a strong, hermetically sealed can. Completed cells are finished in an insulating jacket and are available with a range of standard terminations. Cell designs are available for high power, standard and power limiting applications in a range of sizes from 0.5 Ah up to 30 Ah.

For further information contact Brian Mee, Hawker Siddeley Group, 32 Duke St, St. James's, London SW1Y 6DG, England, or Colin Ashmore, Crompton Parkinson Ltd, 50/52 Marefair, Northampton NN1 1NY, England.

Timers/controllers for industrial use

Selectron Lyss Ltd manufacture a range of timers, controllers and proximity switches for industrial applications, and market them here through M.E.M (Australia) Pty Ltd.

Amongst the product range are a group of single and multi-function 'Selectron GZ' timers, all having programmable time ranges. New to this group are digital quartz-controlled timers with timing ranges from less than a second up to 999 minutes.

A range of 'Seleprom' programmable controllers is also available in either compact or modular form. Further details from M.E.M (Australia) Pty Ltd, 20 Herbert St, Artarmon 2064 NSW, (02) 438-2522. Branches in all states.

NUKED OR NOT?

This radiation detector, produced by the Sin Par Division of Singer Products in the US, requires no batteries, electricity or installation and is claimed to be so sensitive that it will warn you before radiation reaches a dangerous level.

Red beads in the inner cylinder are electrostatically charged. If they float, you haven't been nuked. If they fall, you can tell the degree of stray radiation by the time it takes for the beads to fall. If the plastic housing melts, put your head between your legs and kiss ...

Vicom move

Vicom International Pty Ltd has announced the move of its head office to new premises located at 57 City Road, South Melbourne.

The Company has announced the move as part of its expansion program into military and satellite communications.

The new premises will include management, warehousing and computer operations.

Vicom report they have enjoyed record profits and sales for the last financial year and are expecting the growth rate to continue for the next twelve months.

$1 million solar contract to Philips

Philips has been awarded a contract by the Australian Government to establish a photovoltaic solar cell research, manufacturing and demonstration facility.

The facility will be established in the Philips Microelectronics factory at Hendon, South Australia.

The $1 million contract was awarded by the Industrial Research & Development Incentives Board, and announced by the Minister for Science and Technology, Mr. David Thompson, in June. Apparently the Commonwealth Government desires to develop within Australian industry a manufacturing capability that is based on advanced technology.

Philips has been involved in the development and manufacture of special solar cells and systems at Hendon for some time, and has produced dedicated quantities for special projects including a very successful lightweight military solar system for the Department of Defence.

The emphasis of this contract with Philips calls for industrial research and development at Hendon of advanced process technology which will result in long life and reliability and yet lead to reduction in the cost of manufacture.

The company is to develop process technologies for cell metalisation, encapsulation and cell surface treatment, and research and develop ion implantation techniques as a viable alternative to diffusion using laser technology for subsequent wafer annealing.

Ferguson trannies 'in depth'

Jaycar wish to advise that they now carry the Ferguson range of power transformers in depth.

All printed circuit (5 VA and 12 VA) as well as low profile types 20 VA, 40 VA, and 60 VA are also kept, and chassis-mount types up to 300 VA are available at prices which Jaycar claim are the best in town.

For further information contact Jaycar Pty Ltd, 380 Sussex St, Sydney. (02)264-6688.

Professional multimeters

Emona recently gained the agency for the Akigawa range of test instruments, which includes a range of general purpose multimeters aimed at the professional market.

Top of the range is the Model L-320, primarily intended for solid-state applications. It features four ac voltage ranges from 6 Vac full-scale to 600 Vac, five dc current ranges from 120 uA full-scale to 120 mA and six dc voltage ranges from 300 mV full-scale to 600 V. Six resistance ranges are included, a dB scale and a transistor checker. Sensitivity on ac ranges is quoted as 10 kohms/V, on dc 20 kohms/V.

The meter has a 100° deflection range and a mirrored scale. Further details available from Emona Enterprises, CBC Bank Building, 661 George St, Haymarket NSW 2000. (02) 212-4815.

NOTES & ERRATA

Lab Notes, July, pages 63-65: This article was reprinted from our British counterpart and, while predominantly accurate, something has gone seriously amiss at the end following the heading 'Matched-resistance attenuators'. The article at this point is quite wrong. It would take too much space to correct the problem here, so we suggest you ignore this section, which includes Figures 8 and 9. We have not had difficulties with Ray Marston's material previously, and while material is generally checked for accuracy, drawing and typographical errors, etc, this one slipped through. The British ETI has been notified.

ETI-728 UHF TV antenna, March, pages 41-43: The text states the folded dipole was constructed of aluminium strip 3 mm thick by 12 mm wide, while the diagram on page 43 shows the width to be 25 mm. It is in fact 25 mm wide, but this dimension is not critical and either strip width will work.

A rather obvious, but potentially dangerous error occurred in the circuit on the top left of page 60 ('Power Monitor') in the March issue. It shows the mains active input connected to the earth at the output. The mains active input should instead go to the fuse. Correct your copy now. Correction slips were inserted in the majority of copies distributed.

Reach advanced computer comprehension in a few short hours with the new, mighty

sinclair ZX81

1980 saw a genuine breakthrough — the Sinclair ZX80, world's first complete personal computer for $300, the ZX80 offered a specification unchallenged at the price.

Over 50,000 were sold, and the ZX80 won virtually universal praise from computer professionals.

Now the Sinclair lead is increased: for just $250, the new Sinclair ZX81 means an even bigger saving. At $250 it costs less than the ZX80.

Lower price; High capability

With the ZX81, it's just as simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same microprocessor, but incorporates a new, more powerful 8K BASIC ROM — the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements — the facility to load and save named programs on cassette, for example, or to select a program off a cassette through the keyboard.

Higher specification, lower price — how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

The ZX81 comes complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

New, improved specification

- Z80 a microprocessor — new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function — useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet — but coming soon)!
- Advanced 4-chip design, microprocessor, ROM, RAM, plus master chip — unique, custom-built chip replacing 18 ZX80 chips.

If you own a Sinclair ZX80 . . .

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 — including the ability to drive the Sinclair ZX Printer.

16K-byte RAM pack for massive add-on memory

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

Coming soon — the ZX Printer

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics across 32 columns, and highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981.

For your free catalogue on software, send stamped, self-addressed envelope to Sinclair Equipment (Australasia) P/L.

ET1

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ZX81

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86-88 Nicholson Street, Abbottsford, Victoria, 3067. Telephone: 419 3033.

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	Ready assembled ZX81 Sinclair Personal Computer including mains adaptor, leads, BASIC manual	$250	
	16K-BYTE RAM pack	$150	
	8K-ROM	$ 75	
	ZX Printer (to be announced)		

Total _____

I enclose cheque/Bankcard/Diners/Amex ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

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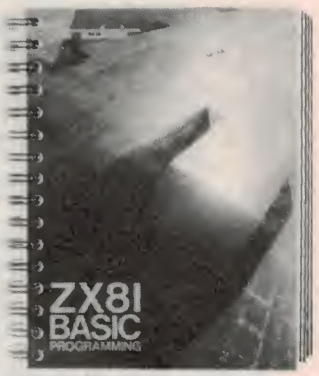
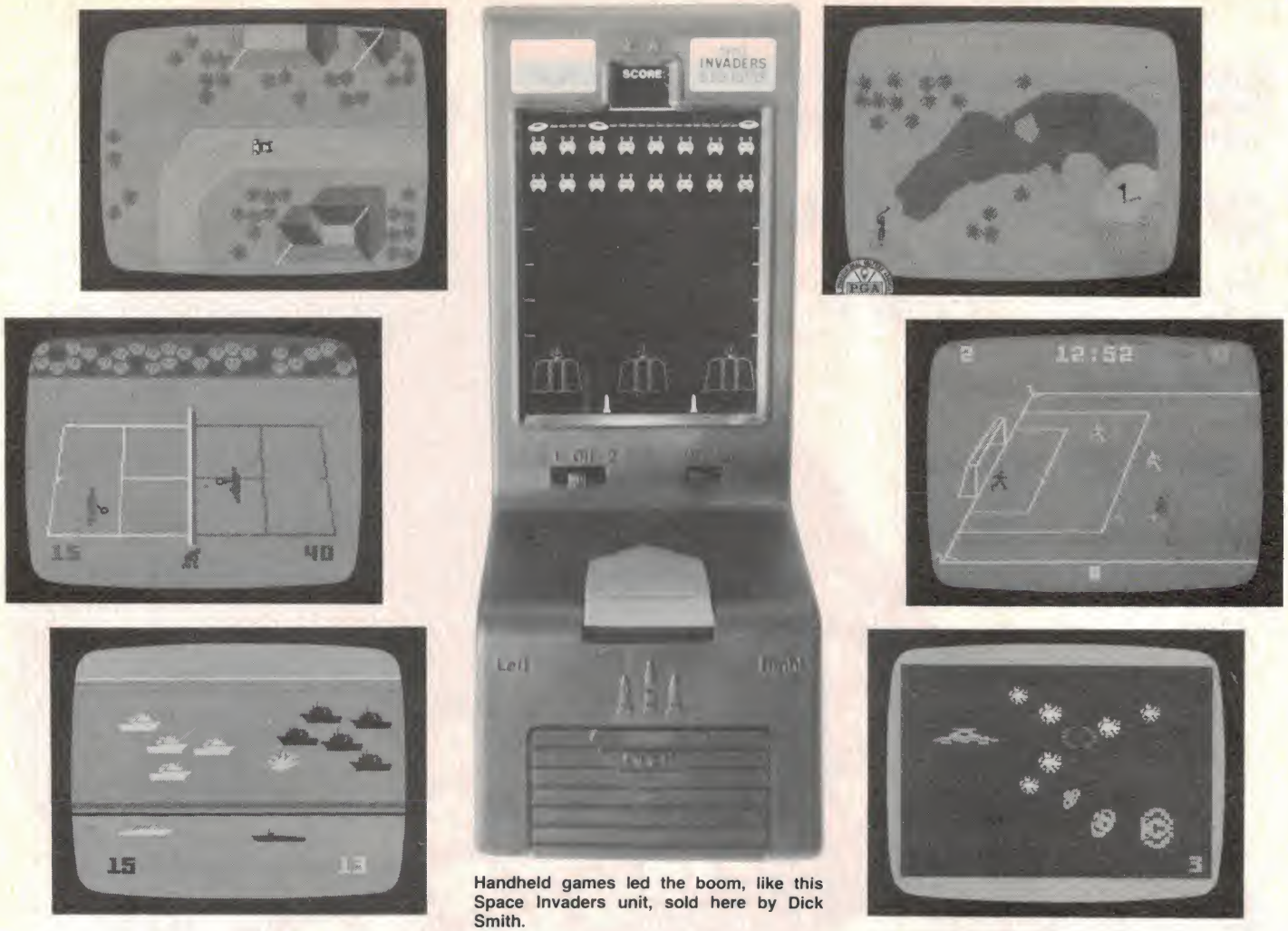


NEW BASIC MANUAL SINCLAIR ZX81

Every ZX81 comes with a comprehensive, specially written manual — a complete course in BASIC programming, from first principles to complex programs.



Handheld games led the boom, like this Space Invaders unit, sold here by Dick Smith.

Game, set, match

Dennis Lingane

An enormous boom has arisen in the electronic games market — now worth a staggering $2.5 billion and slated to rise 40% in the next 12 months — and the peak is not yet in sight. It's one area of the consumer electronics industry where the US manufacturers hold sway. The Japanese have yet to catch on and the Europeans are nowhere in sight. Developments seem set to force further development in other areas — like TV technology, for example.

IF YOU WERE planning to buy a video games system this Christmas for the family, be warned — the complete production world-wide has already been sold for this year!

So don't front up to your games shop on Christmas Eve and expect to get an Atari system, because there probably won't be one left — book now!

The boom in video games has taken the industry by surprise.

Warner Bros bought Atari in 1976 when it was a backyard operation making a ping-pong arcade game. Atari now fills 20 buildings in Silicon Valley outside San Francisco and is one of the most profitable divisions of the Warner Communications organisation, which encompasses satellite TV, cable TV, movies, book publishing, record production and sports management. Atari doubled its income between 1979 and 1980, while operating income rose *tenfold*. 1980 saw Atari with $513 million revenue ($238 million the previous year) and an operating income of $69.9 million.

The complete electronic games industry is now riding on the crest of a $2.5 billion tide that is expected to reach $3.5 billion next year.

The handheld games follow the traditional toy sales cycle with the

biggest sales around Christmas. But the programmable video games like those from Atari and Hanimex sell all year round. Mattel and Magnavox will be selling similar game centres in Australia eventually.

The challenge before the electronic games industry is to keep coming up with new games. Atari, for example, has more than doubled its games research staff from 28 to near 60, and they all have one mission in life — play and invent games.

The industry has created a need for a new type of person — somebody who can program computers and understands computing but is also a games enthusiast. The trouble with computer programmers, according to one of Atari's executives, is that they don't have any imagination.

The handheld games have slowed down in sales as the programmable systems have speeded up. So it is with some caution that retailers and the industry approach the mass marketing of handheld games over the next few years. The other question mark on the horizon is what the effect of the growth of home computers will be on the electronic games market.

Mattel's Intellvision system is based on a 16-bit microprocessor (!!!) and represents the sophistication now available in video games. High resolution graphics (examples opposite) with objects that can be rotated through 360° on screen are featured and no game plays the same way twice! Attach a keyboard (to come) to the 'master component' shown here and you've a fully-fledged home computer! The Intellvision will be released here this month through Lifestyle Electronics, part of the Consolidated Press Holdings Group.

When electronic games were launched the public found it difficult to accept a figure of around $50 for a handheld toy. Then came the $279 Atari games centre with cartridges costing around $40 - $60, and within two years the price was no longer a barrier. Now we have Commodore releasing their VIC and Atari bringing out its Model 400 home computer, both of which will sell for little under $500!

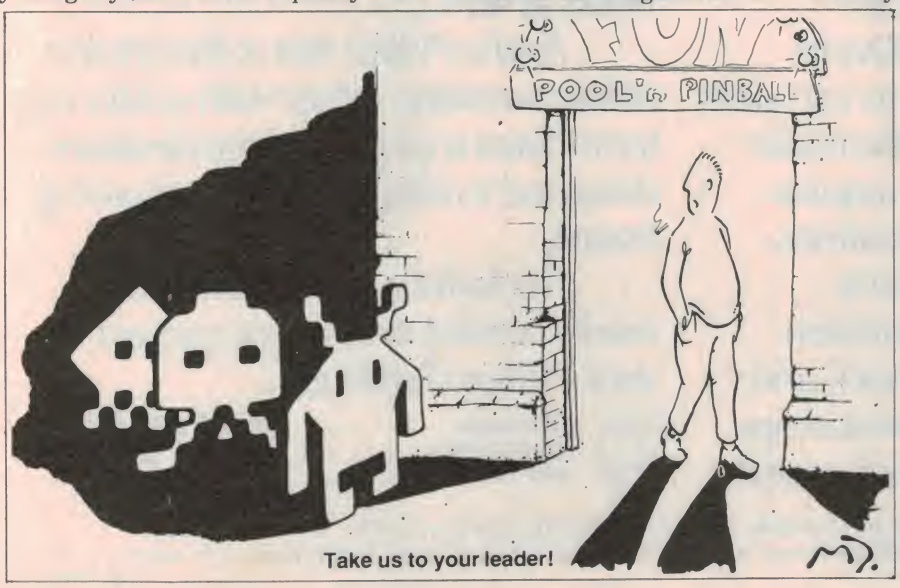
Will parents regard the new technology as a dual-purpose investment, buying their children a home computer as a games centre and hoping that they will learn computing from it as the years go by (and therefore qualify better for employment)? If this pattern does emerge it may see the home electronic games centre losing out to the home computer, but in the meantime Atari and companies like it seem assured of a profitable future. After all, the computer kids of the future will still need something to start them on their electronic path in life.

According to a spokesman at Atari's head office, the company still has a fair few tricks up its sleeve to make programmable video games — which still have the advantage of being cheaper than computers — more attractive to consumers. They claim that the limitations on the designers are now basically those of the television set itself, and plans are afoot for producing high-definition TV sets to make games more graphic, and even for introducing three-dimensional TV. Voice control could be seen in the near future, with a twelve-word vocabulary used instead of pushbuttons to give commands. In the meantime Atari has released infrared controls for its games to add even more novelty, plus giving enthusiasts the convenience of no trailing wires.

Sidney Samole, head of Fidelity Electronics (manufacturer of 90% of electronic board games), also sees no clouds on his immediate horizon. He has recently been granted a patent for electronic board games which his company launched in 1976, and anticipates royalties from other manufacturers riding on the back of the boom he created. He has already sued two companies and the result is pending.

Some electronic board games, like chess, backgammon and bridge, seem destined to enjoy the same eternal popularity as their manual versions. Fidelity has released a battery-operated sensory chess set that should be popular with travellers, enabling them to brush up on their game in transit and help to while away tedious hours of travel.

So all in all the electronic games manufacturers are doing all right, and whilst the expanding home computer boom might eventually make some sort of hole in the market, it's a fair bet that electronic games will have a place in home entertainment for decades to come.●



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For further information tick reader service enquiry or contact your Philips distributor.

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Series 5000 stereo control preamplifier

Designed as the perfect partner to our Series 5000 MOSFET stereo amplifier, the stereo control preamplifier has been designed with equal attention to quality and detail. This month David Tilbrook explains the principles behind the design of the moving coil and moving magnet stages and gives details on constructing them.

David Tilbrook

JUST AS a loudspeaker represents a non-linear load to the output stage of a power amplifier, a moving magnet or moving coil cartridge represents a non-linear source impedance to the input stage of a preamplifier. This is the cause of many of the problems associated with any preamp.

Both moving coil and moving magnet cartridges generate electrical signals through the interaction of a coil of wire and a magnetic field. The signal voltage produced is therefore proportional to the relative velocity between the coil and the magnet assemblies. This relationship is predicted by Faraday's law of induction, expressed mathematically as:

$$\mathcal{E} = -\frac{d\varnothing}{dt}$$

where $\mathcal{E}$ is the signal voltage at any instant and $\varnothing$ is the magnetic flux.

The signal voltage produced at any instant is proportional to the rate of change of flux with respect to time,

i.e: $\frac{d\varnothing}{dt}$

The design of the cartridge must ensure that a linear relationship exists between the position of the stylus cantilever assembly and the magnetic flux.

Our adaptation of a famous scene from Irving Stone's book about Michelangelo, 'The Agony and the Ecstasy'. During the time Michelangelo was painting his masterpiece frescoes in the Sistine Chapel the Pope continually asked "... when will you make an end?". Likewise, Roger Harrison has kept asking David Tilbrook when the Series 5000 would finish. The answer was the same in both cases! (Thanks to the cartoonist, Brendan Akhurst, and the choirboys: Jack O'Donnell of Altronics, Dick Smith, and Gary Johnston of Jaycar. Collyn Rivers looks on from the sidelines).

In this way changes in the position of the stylus give rise to changes in the magnetic field intensity. So the rate of change of stylus position with respect to time will be proportional to the signal voltage, i.e:

$$\mathcal{E} \propto \frac{dx}{dt}$$

where $\mathcal{E}$ is the signal voltage and x is the stylus displacement from its equilibrium position.

This means that the waveform actually 'on' the grooves is not proportional to the signal voltage itself. Instead it is proportional to the integral of the signal waveform. If a square wave, for example, is to be produced from a record, the waveform as seen in the groove with a microscope will be a triangle wave.

Since the signal voltage is proportional to the velocity of the stylus, the signal slope is proportional to the *acceleration* of the stylus. In order for high signal slopes to be reproduced accurately by the cartridge it is important that the mass of the stylus cantilever assembly be kept as small as possible. At the same time, however, it is important to realise that the cartridge cantilever assembly and its associated suspension and magnet/coil system form a resonant mass-spring system analogous to a complex electrical series resonant circuit.

At one particular frequency, called the resonant frequency, the impedance of the cartridge will no longer be related linearly to the driving force on the stylus, and distortion results. To overcome this problem two techniques are used simultaneously.

Firstly the resonant frequency of the cartridge is moved to a frequency below the audio spectrum. Using the damped mass-spring model of a magnetic cartridge we can predict that the resonant frequency will depend on the mass of the stylus cantilever assembly and on the 'springiness' of the cantilever's suspension. This springiness is characterised by a number, often given the symbol k, called the spring constant. Spring constant is defined in terms of the force needed to bring about a certain compression or extension of the spring. Stiffer springs have a higher value for k. The spring constants associated with magnet cartridges, however, are so small that the numbers are hard to interpret. For this reason cartridge manufacturers usually specify this quantity by quoting the reciprocal of the spring constant, $\frac{1}{k}$, called *compliance*. Stiffer suspension systems have lower compliance figures.

As stated earlier, the cartridge resonant frequency is a function of both the mass and the compliance of the cantilever and suspension system. The damped resonance mass-spring model of a magnetic cartridge predicts that the resonant frequency will be given by the equation:

$$f = \frac{1}{2\pi\sqrt{(mC)}}$$

where m is the mass of the cantilever/stylus system and C is the compliance of the stylus suspension system. ▶

We can offer a career- not just a job!

Enjoy electronics as a hobby?
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At Dick Smith Electronics, hundreds of electronics enthusiasts just like you have found satisfying and rewarding positions.
We're expanding - and we need more people. In all facets of our operation. The following positions are vacant NOW: if you'd like to work with us, why not give us a call!

TRAINEE MANAGERS:

We need managers for the new stores we're opening right around Australia - and overseas. What better way to prepare for this than by training in a current Dick Smith Store. If you're between 18 and 30, have a hobby background in electronics and retail experience, give us a call. We'll probably place you in a store close to home (we have 21 stores - in most states).

Contact Mr Bob Johnson, Retail Supervisor (02) 888 3200 or ask your local store manager.

TECHNICAL SALES STAFF/ SPECIALISTS:

You could join our young sales team - or even be a specialist salesman if you have a particular interest. (Amateur Radio, Computers, etc). You'll be trained thoroughly in being a sales professional, and you'll be dealing with interesting people involved in electronics: just like you are at the moment!

Contact your local store manager.

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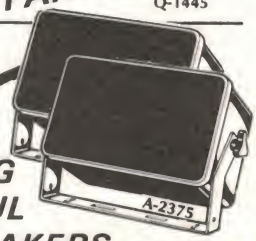

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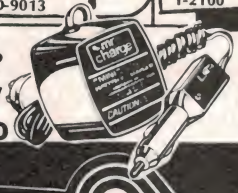

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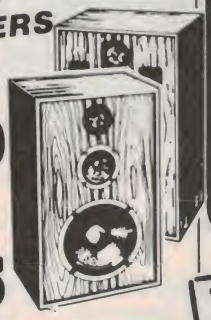

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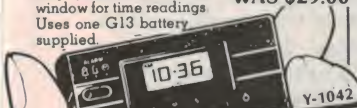

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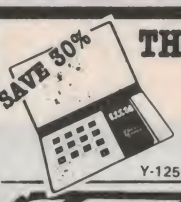

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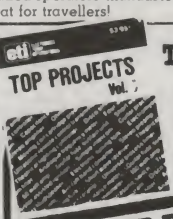

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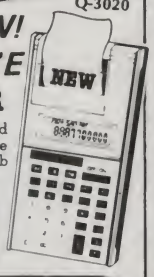

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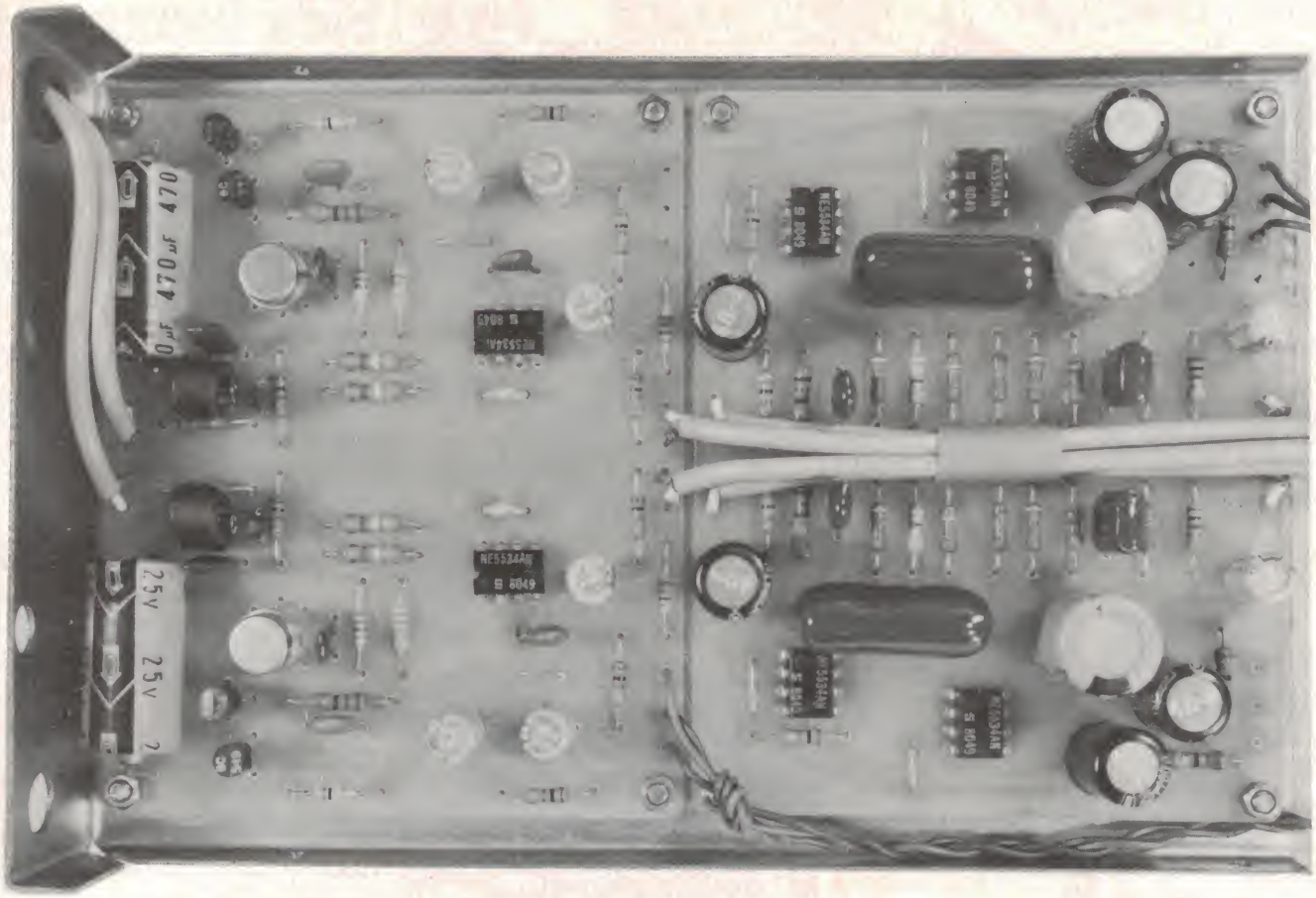


The low level Series 5000 Preamp input stages — for moving magnet and moving coil cartridges — are housed in a steel enclosure inside the main preamp case. This is a view inside the enclosure; moving coil stage to the left, moving magnet stage at right.

(Notice that the equation for the resonant frequency of magnetic cartridges has exactly the same form as the equation for the resonant frequency of an electrical resonance circuit, i.e:

$$f = \frac{1}{2\pi\sqrt{(LC)}}$$

where C in this case is capacitance and L is inductance. The fact that a mechanical system like the stylus cantilever assembly of a cartridge should be described by such an equation is another striking example of the consistency of nature.)

The equation predicts that the resonant frequency of the cartridge can be decreased by increasing either the mass or the compliance. Since the mass of the moving parts in the cartridge must be kept small so the stylus can respond quickly to changes in the record groove, the compliance must be increased until a suitably low resonant frequency is obtained. Most high-quality magnetic cartridges have resonant frequencies below 10 Hz.

The second technique used to overcome problems associated with this resonance characteristic is to decrease the Q of the system by damping the resonance with a suitable combination of mechanical and electrical losses. Mechanical damping is obtained by deliberately introduced friction within the cantilever suspension system. The cantilever is often terminated into a rubber mounting block for this purpose. The electrical damping comes about as a direct consequence of the law of conservation of energy. The cartridge is acting as a generator, delivering power to the input resistance of the pre-amplifier. Since energy is absorbed by this load resistance the Q of the cartridge resonance is decreased.

Until recently most stereo magnetic cartridges consisted of two fixed coils between the poles of a small magnet attached to the cantilever. Modulation of the record groove produces movement of the magnet, changing the magnetic flux and generating the signal voltage.

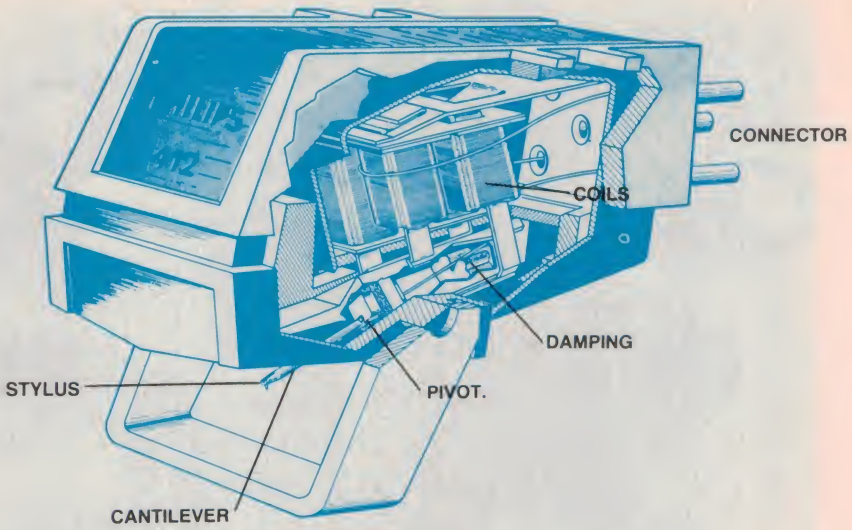
The coils usually have a large number of turns so that a reasonable signal voltage can be produced (typically in the order of 20 mV). The resistance of these coils usually ranges between 200-1000 ohms, but their impedance can be much higher, especially at high frequencies where the inductance of the coils becomes important. This type of cartridge is sometimes called a moving magnet cartridge to distinguish it from the more recently developed moving coil types. The relatively high reactive component of the cartridge impedance combined with the effects of the natural cartridge resonances makes it essential that the input impedance of the moving magnet (MM) input stage have well-defined characteristics if best performance is to be obtained from this type of cartridge. Most MM cartridges require a load impedance consisting of 47k of resistance shunted by several hundred picofarads. This capacitance is often provided by the shielded cable, but most cartridges require some additional capacitance across the MM input. In exceptional cases the input capacitance due to the shielded cable is too high. In these cases the length of the shielded cable used between the turntable and the MM amp should be decreased until the correct value is achieved.

In order to obtain the flattest frequency response possible from an MM cartridge it is essential that the

load resistance be constant over the complete audio spectrum *and beyond*. For this reason measurements done on the input resistance of MM amps at one particular frequency (usually 1 kHz) are practically useless. Many input stages exhibit a characteristic of falling input resistance at high frequencies. The input resistance of a bipolar transistor, for example, even with a small amount of emitter current, is insufficient to ensure a constant resistive load to an MM cartridge. The common two or three transistor phono stages of a few years ago often suffered badly from this problem, degrading the top end performance of an otherwise good MM cartridge. The problem occurs because all bipolar transistors have decreasing gain at high frequencies.

The most common method used to increase the input impedance of a bipolar input stage is through the use of negative feedback. The decrease in gain of the individual transistors in the stage at high frequencies decreases the overall open loop gain of the stage, which in turn decreases the amount of negative feedback available. Furthermore, the negative feedback is often applied at the emitter of the first transistor. The problem with this configuration is that the phase response in the negative feedback loop can easily be affected by the complex reactances of the cartridge and connecting cables, producing unwanted frequency response variations, or even instability in some cases.

All these problems come under the general heading of 'cartridge impedance interaction', and represent the most important single reason for the difference in sound between preamplifiers. Most preamps suffer from some degree of cartridge impedance interaction and in *many* cases the effects are pronounced. ▶



View inside a typical high-quality moving magnet cartridge, the Philips GP412.

SPECIFICATIONS

ETI-478MM MOVING MAGNET INPUT STAGE

Gain: 74, 1 kHz

Frequency response: Conforms to RIAA Equalisation ±0.2 dB. (This is the performance of the prototype. The actual figure obtained will be determined by the accuracy and long-term stability of the components used.)

Total harmonic distortion: ‹0.001%, 1 kHz, 10 mV RMS input

Headroom: ›28 dB with respect to 5 mV RMS input signal, i.e: 135 mV RMS max.

Noise: Total equivalent input noise, 122 nV 'A', input shorted, 216 nV flat, input shorted.

S/N ratio:

	1 mV	5 mV	10 mV
Flat	73 dB	87 dB	93 dB
A-weighted	78 dB	92 dB	98 dB

IDEAL RIAA Hz	IDEAL RIAA dB	MEASURED – SERIES 5000 dB
2	−0.2	−0.2
4	+5.7	+5.7
8	+11.2	+11.2
16	+15.4	+15.4
20	+16.3	+16.2
30	+17.0	+17.0
40	+16.8	+16.8
50	+16.3	+16.2
80	+14.2	+14.2
100	+12.9	+12.8
150	+10.3	+10.2
200	+8.2	+8.1
300	+5.5	+5.4
400	+3.8	+3.7
500	+2.6	+2.6
800	+0.7	+0.7
1k	0.0	0.0
1k5	−1.4	−1.3
2k	−2.6	−2.4
3k	−4.8	−4.7
4k	−6.6	−6.6
5k	−8.2	−8.1
6k	−9.6	−9.6
8k	−11.9	−11.9
10k	−13.7	−13.8
15k	−17.2	−17.1
20k	−19.6	−19.5

SPECIFICATIONS

ETI-478MC MOVING COIL INPUT STAGE

Gain: 24

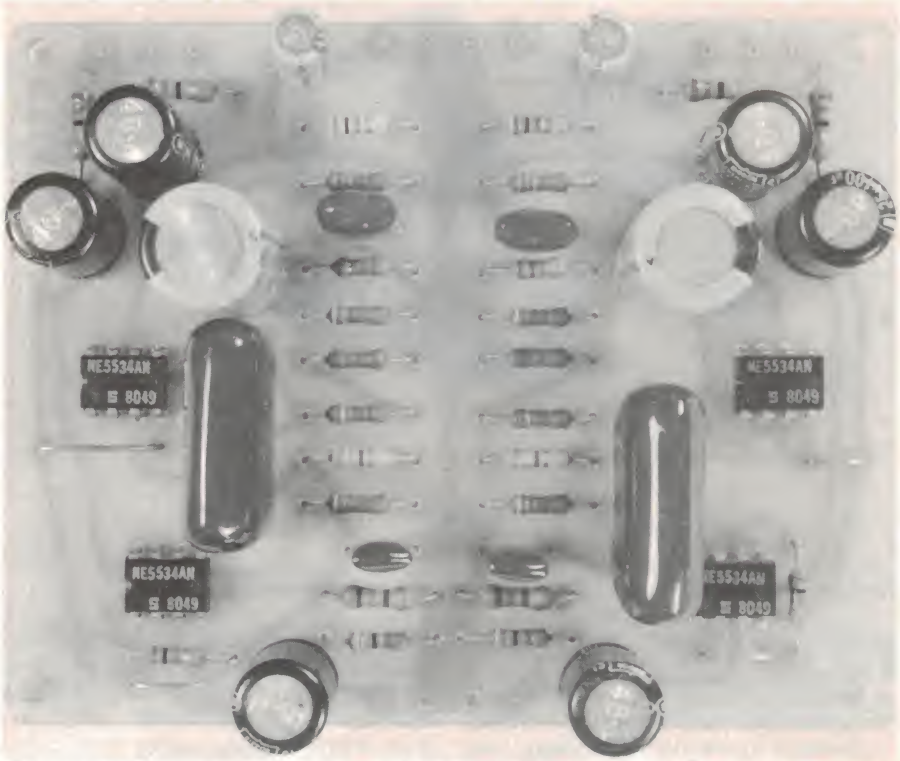
Frequency response: 7 Hz-135 kHz +0, −1 dB

Total harmonic distortion: ‹0.003%, 1 kHz, 30 mV input

Noise: Total equivalent input noise:
83 nV flat, input shorted.
42 nV 'A', input shorted.
56 nV flat, after RIAA Eq., input shorted.
34 nV 'A', after RIAA Eq., input shorted.

S/N ratio of MC input stage after RIAA Equalisation:

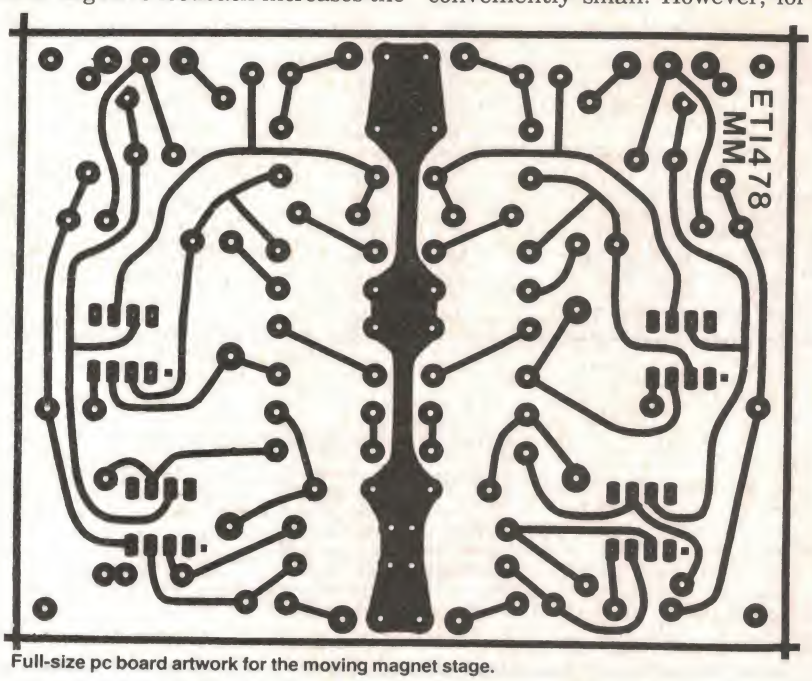
	60 μV	200 μV	500 μV
Flat	61 dB	71 dB	79 dB
A-weighted	65 dB	75 dB	83 dB



The completed moving magnet stereo input stage (ETI-478MM). Note that this project may also be incorporated in existing equipment if you wish.

The Series 5000 stereo control preamp has been designed specifically to overcome the problem of cartridge impedance interaction. This has been achieved by separating the MM input stage into two separate active stages (see Figure 1). The first stage consists of a single NE5534AN configured as a linear amplifier with a closed loop gain of around 8.3. The large amount of overall negative feedback increases the input impedance of the stage so that the measured input impedance is simply that of the 470k resistor, R2. Since the 5534 has a small signal bandwidth of around 10 MHz without additional compensation, the input impedance will remain unchanged over a very wide frequency range. The high input impedance of this stage would usually allow the input capacitor C2 to be conveniently small. However, for best noise performance the value must be increased substantially. This is covered in detail later in this article.

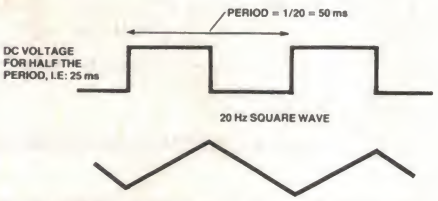
Capacitor C2 is necessary since it is not advisable to allow dc current from the first stage to flow through the cartridge. The value of C2 used here is 100μ, and this sets the lower −3 dB point well below 1 Hz. The upper −3 dB point of this stage is well above 100 kHz. An extended frequency response is necessary so that the accuracy of the RIAA equalisation is not affected by frequency response variations that might otherwise occur in the first stage.



Full-size pc board artwork for the moving magnet stage.

RIAA equalisation

We said earlier that the signal voltage produced by a magnetic cartridge is proportional to the velocity of the stylus. If a low frequency signal is to be reproduced by a magnetic cartridge, large excursions of the stylus are necessary. If for example a 20 Hz square wave is to be reproduced by the cartridge then the cartridge must produce a dc voltage at its output for a period of 25 ms.



In order to do this the stylus must move at a constant speed for this period of time, and therefore the waveform in the record groove is a triangle wave, as stated earlier.

Typical output voltages from moving magnet cartridges are in the order of 1 mV-2 mV for a stylus velocity of 1 cm/sec. So if the peak voltage required on the square wave was, say, 10 mV, a stylus velocity of 10 cm/sec would be required for a medium-sensitivity cartridge, so the stylus must move at a constant speed of 10 cm/sec for a 25 ms time interval. The stylus therefore moves a total distance of 2.5 mm! On a stereo record the channels are cut in opposite walls of the record groove. If a low frequency mono signal is to be produced, both sides of the record groove force the stylus away from its equilibrium position, and a large vertical stylus excursion results. In the case of our square wave, the vertical excursion would be roughly 3.5 mm, which is simply not possible. The record would have to be as thick as most turntable platters!

Two measures are used to overcome

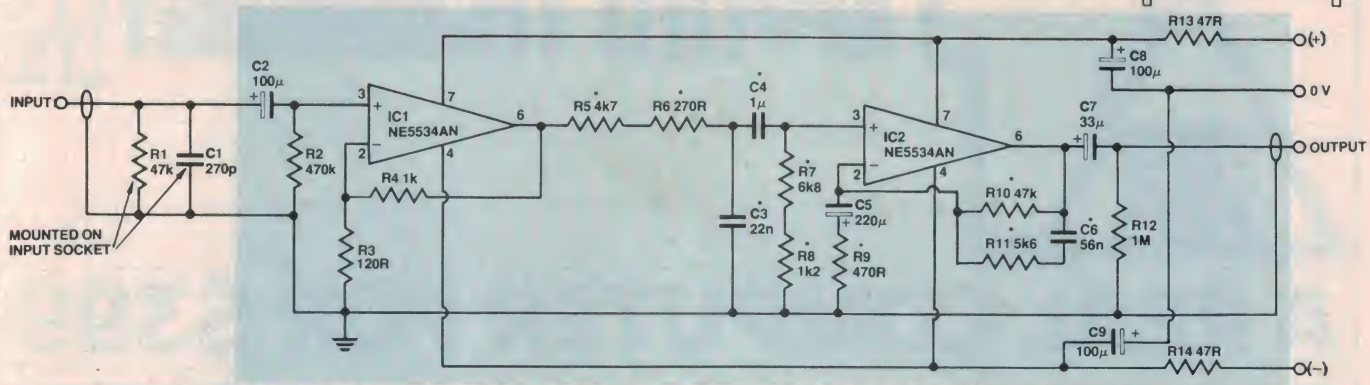


Figure 1. **Circuit of one channel of the moving magnet input stage (ETI-478MM). Note that the RIAA equalisation is incorporated in this stage. Components for the other channel are designated R101, C101, IC101, etc.**

* DENOTES COMPONENTS ASSOCIATED WITH THE RIAA EQUALISATION

this problem. Firstly the two channels are recorded on the record 180° out of phase, so that the large vertical excursion is replaced by a large horizontal excursion. Secondly, the low end of the frequency response is attenuated before the recording process, so the stylus excursions are decreased. The specific amount of low frequency attenuation is defined as that which would be caused by a first-order high-pass filter with a time constant of 318 μs (i.e: the filter would be formed by an ideal resistor/capacitor filter, in which R x C = 318 μs). To convert from these time constants into frequency, simply apply the equation:

$$f = \frac{1}{2\pi t} \text{ (t = time constant)}$$

This is equivalent to a 6 dB/octave filter with a −3 dB point at 500 Hz. To prevent the low end from rolling off indefinitely a second 6 dB/octave filter is used to flatten the response again at 3150μs or 50 Hz. After this equalisation is applied, the stylus excursion of the 20 Hz square wave, for example, is decreased to around 0.3 mm, which is manageable.

Similar problems occur at very high frequencies. If we consider now a 20 kHz square wave at the same output voltage and hence the same recording velocity, the stylus now only moves a total distance of 2.5 μm! Such minute distances are only a few orders of magnitude larger than the surface irregularities in the vinyl, so at these frequencies the signal to noise ratio is poor. To overcome this problem the top end is recorded at a higher level, which increases the stylus excursions and thereby improves the signal to noise ratio. The modifications to the recorded frequency response are referred to as RIAA pre-emphasis or equalisation (RIAA stands for Recording Institute Association of America), and must be corrected for by the input stage. The RIAA playback equalisation must boost the bass end and attenuate the treble end of the audio spectrum to return the overall frequency response to that of a linear system.

Since the low end is amplified most of all by the RIAA playback signal, any turntable rumble or cartridge/turntable resonances will be amplified. Modern power amps are quite capable of delivering full power to a pair of loudspeakers at 10 Hz or below, so appreciable amounts of subsonic content can be fed to the loudspeaker. This is potentially dangerous to the bass driver and decreases the clarity and accuracy of the low end.

In an attempt to overcome this problem the RIAA has proposed a change to its playback equalisation curve. The extreme bass frequencies are attenuated on playback by the addition of another time constant. This takes the form of a single-pole RC filter with a time constant of 7950 μs, i.e: a −3 dB point of 20 Hz. Since the frequency response is already flattened by the 3150 μs time constant, this new time constant gives a 6 dB attenuation rate below about 20 Hz. The resulting RIAA playback equalisation is shown in Figure 2. Note that there are four time constants associated with the proposed RIAA equalisation: 7950 μs, 3150 μs,

HOW IT WORKS — ETI-468MM

The input from a moving magnet cartridge is connected to the non-inverting input of an NE5534AN via capacitor C2. R2 provides a dc current path to the input of the differential pair in the op-amp. The gain of this stage is determined by the ratio R4 to R3, which is around 8.3 in this case.

The resistor R1 provides a fixed resistive load necessary for best performance from an MM cartridge. Most cartridge manufacturers recommend that the input resistance be shunted by a certain amount of capacitance. This is the purpose of capacitor C1, the value of which should suit most cartridges. If you wish to optimise the value of this capacitor don't forget to allow several hundred picofarads for the shielded cable capacitance.

The best way to ensure that the cartridge is loaded correctly is with a test record containing a square wave track, and an oscilloscope. With the correct cartridge load and a good tonearm/cartridge combination, a good square wave can be obtained.

The value of resistor R1 at 47k is effectively in parallel with R2, giving an input resistance of 43k, slightly below the 47k normally used for MM input stages. This is unimportant, however, and will not affect performance of the cartridge. The important thing is that the value of this resistance remain constant over the full audio spectrum and beyond. In any case the value of the input resistance is easily changed by increasing the value of R1 to, say, 56k instead of 47k.

The output of the first stage is fed to two 6 dB/octave RC filters that provide one half of the RIAA equalisation. Resistors R5, R6 and capacitor C3 form a first-order low-pass filter set at the 75 μs time constant of the RIAA curve. At these frequencies (around 2122 Hz) the 1 μF capacitor appears as a short circuit connecting R7 and R8 in parallel with the capacitor C3. This must be compensated when choosing the value of C3 to ensure the correct RIAA equalisation. Similarly C4, R7 and R8 form a low frequency high-pass filter set at 20 Hz (the 7950 μs time constant).

The output of these two filters is fed to the input of the second op-amp stage. The remaining RIAA equalisation is accomplished by the feedback loop around this stage. At frequencies below 500 Hz the 56n capacitor C6 has a relatively high impedance. The voltage gain is therefore determined by resistors R9 and R10. At higher frequencies, however, where the impedance of C6 is less, both resistors R10 and R11 are in circuit. The capacitor C5 decreases the gain, at dc, of the second stage to unity, ensuring a low dc offset at the output and therefore symmetrical output stage clipping.

The 1M resistor R12 ensures that the dc voltage on the output remains at 0 V. This is important so that operation of the selector switch following the stage will not cause thumps in the output.

Resistors R13, R14 and capacitors C8, C9 isolate the supply to the stage to decrease the effects of interactions between stages and to ensure freedom from 50 Hz ripple.

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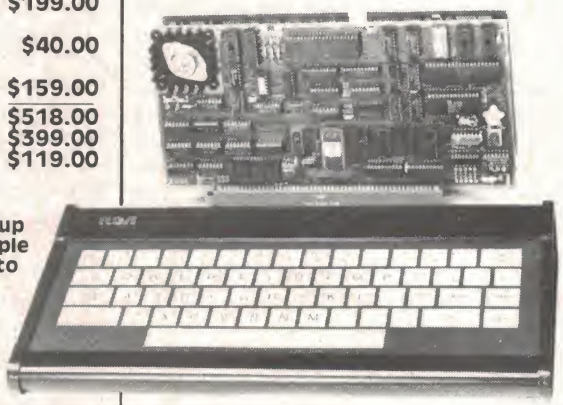

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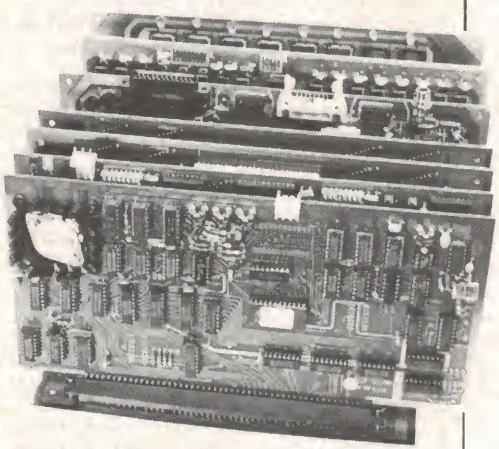

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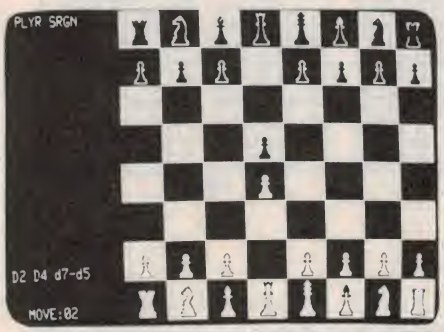

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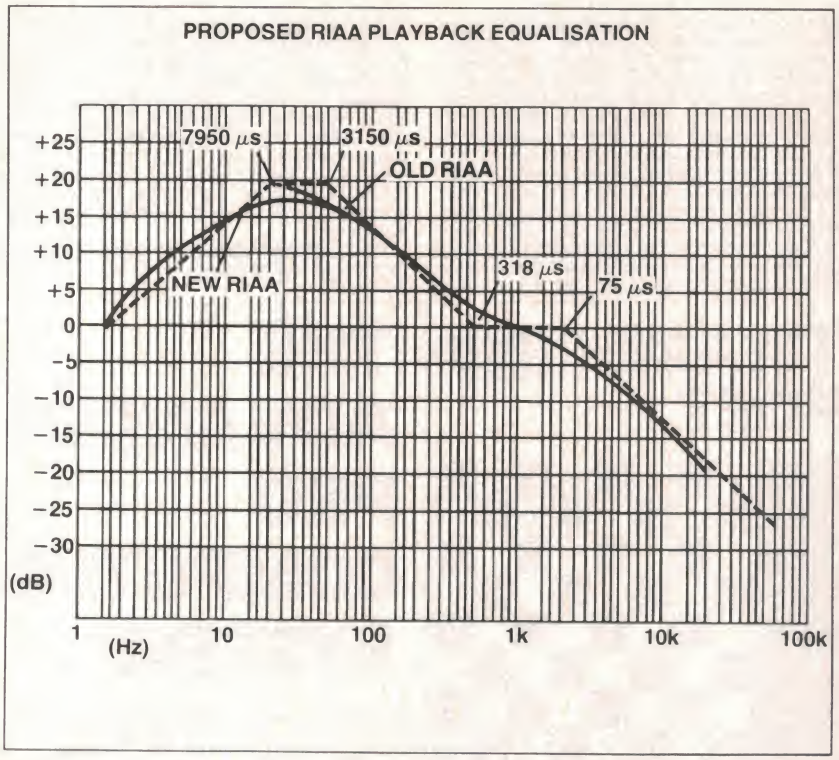
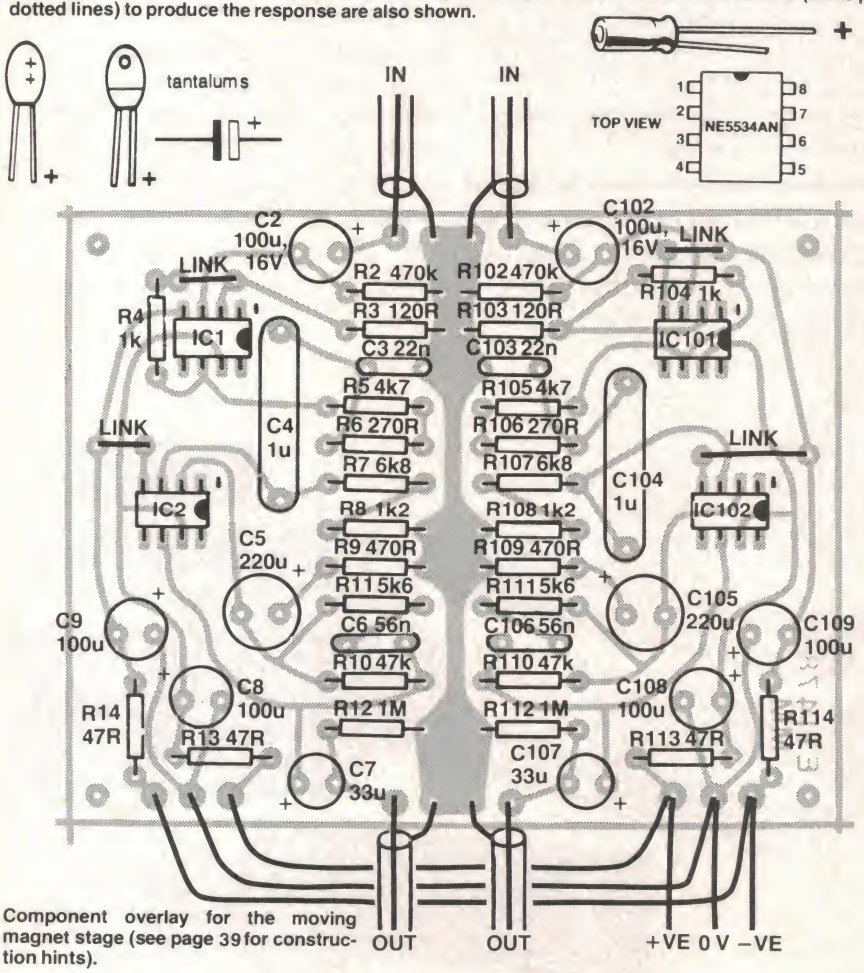


Figure 2. **Old and 'new' RIAA equalisation curves (solid line). The individual time constants (Bode plot — dotted lines) to produce the response are also shown.**

318 μs and 75 μs. These are shown on the Bode plot, which is the dotted line in Figure 2. It should be emphasised, however, that the introduction of this low frequency time constant is not sufficient to remove severe cases of turntable or tonearm resonance. Some preamps incorporate multiple-order subsonic filters that offer a very fast roll-off below 20 Hz. The problem with this, however, is that severe cases of tonearm resonance or rumble generate distortion harmonics well above 20 Hz, into the audio spectrum. The only real cure is to remove the problem at the turntable or tonearm.

Many different techniques are used to give the preamp the desired equalisation. The most common is to include the RIAA equalisation circuitry into the feedback loop of the first stage. Figure 3 shows a very simple MM input stage of the general type often found in medium-priced amplifiers.

Transistor Q1 functions as a standard common emitter amplifier offering a voltage gain that is determined by the total impedance from its collector to earth divided by the total impedance from its emitter to earth. Transistor Q2 is a PNP transistor but functions in an identical manner. The product of their two voltage gains is called the open loop gain of the stage. If a current path is now made available from the output of Q2 back to the emitter of Q1, the voltage



Component overlay for the moving magnet stage (see page 39 for construction hints).

PARTS LIST — ETI-478MM FOR STEREO PC BOARD

Resistors ..... all ¼W metal film
R1, R101 ..... 47k
R2, R102 ..... 470k
R3, R103 ..... 120R
R4, R104 ..... 1k
R5, R105 ..... 4k7, 1%
R6, R106 ..... 270R, 1%
R7, R107 ..... 6k8, 1%
R8, R108 ..... 1k2, 1%
R9, R109 ..... 470R, 1%
R10, R110 ..... 47k, 1%
R11, R111 ..... 5k6, 1%
R12, R112 ..... 1M
R13,R113,R14, R114 ..... 47R

Capacitors
C1,C101 ..... 270p ceramic
C2,C102 ..... 100μ, 16 V electro.
C3,C103 ..... 22n greencap
C4,C104 ..... 1μ greencap
C5,C105 ..... 220μ, 16 V electro.
C6,C106 ..... 56n greencap
C7,C107 ..... 33μ, 25 V electro.
C8,C108,C9,C109 ... 100μ, 25 V electro.

Integrated circuits
IC1,IC101 ..... NE5534AN
IC2,IC102 ..... NE5534AN

Miscellaneous
1 x ETI-478MM pc board; assorted mounting hardware; shielded cable.

gain will now drop to a new figure called the closed loop gain. This is negative feedback, and it has the effect of decreasing the distortion and increasing the input impedance of the stage. (See Series 5000 MOSFET Power Amp articles in ETI Jan., Feb., March 1981 for more information on negative feedback.)

The RIAA equalisation is introduced by applying the negative feedback via a network with a frequency dependent impedance. However, since this stage relies on the presence of negative feedback to ensure a satisfactorily high input impedance, the input impedance will vary as a function of frequency. The cartridge, however, must be loaded by a constant resistance if cartridge impedance interaction is to be avoided. Furthermore, since the negative feedback is coupled to the complex output impedance of the cartridge via the base-emitter junction of Q1, the negative feedback and hence the frequency response of the stage can be affected by the cartridge itself. As a result this type of stage can suffer badly from cartridge impedance interaction.

In the development of the Series 5000 preamp several input stage configurations were tested for noise, distortion and cartridge impedance interaction. When a medium-priced moving magnet cartridge was connected to a stage like that in Figure 3, severe cartridge impedance interaction was evident. The frequency response of the preamplifier peaked above 2 dB at 13 kHz and rolled off rapidly above 15 kHz. The same cartridge when connected to the Series 5000 MM amp exhibited quite a good frequency response to beyond 20 kHz, and the frequency response graph obtained was identical to that when a FET buffer amp was placed between the cartridge and the input stage, indicating almost total lack of cartridge impedance interaction in the 5000 stage. This is a result of the use of the separate linear gain stage formed by IC1 (see Figure 1) to isolate the cartridge from the RIAA equalisation.

The Series 5000 Preamp conforms to the proposed RIAA equalisation in Figure 2. The 75 μs and 7950 μs time constants are obtained by passive RC filters at the output of the first stage. Resistors R5, R6 and capacitor C3 form a simple 6 dB/octave low-pass filter with a −3 dB point at 2122 Hz, and

$$t = \frac{1}{2\pi f} = \frac{1}{2\pi(2122)} \doteqdot 75\ \mu s.$$

Capacitor C4, together with resistors R7 and R8, form a 6 dB/octave high-pass filter with a −3 dB point at 20 Hz,

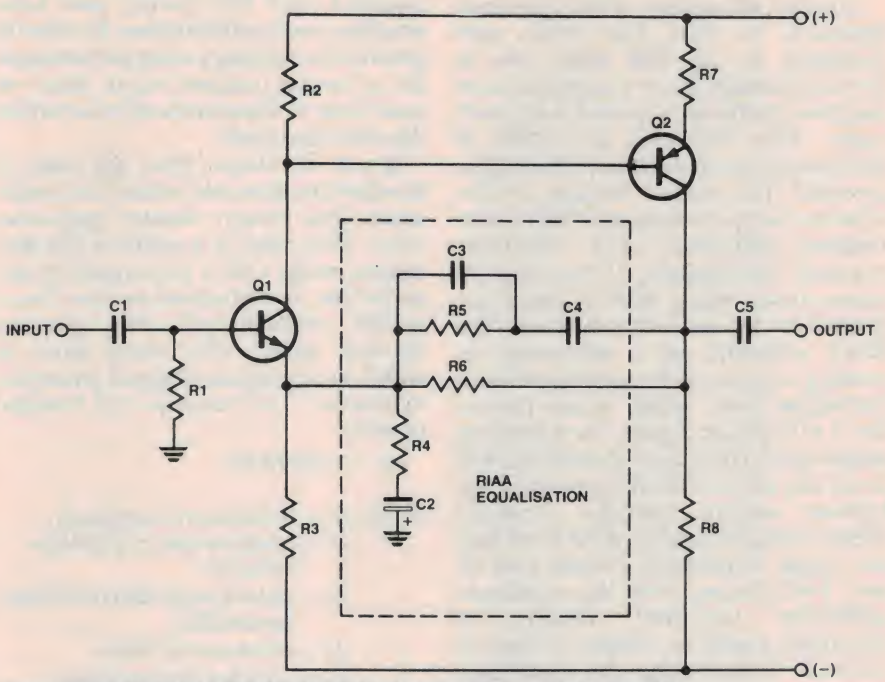
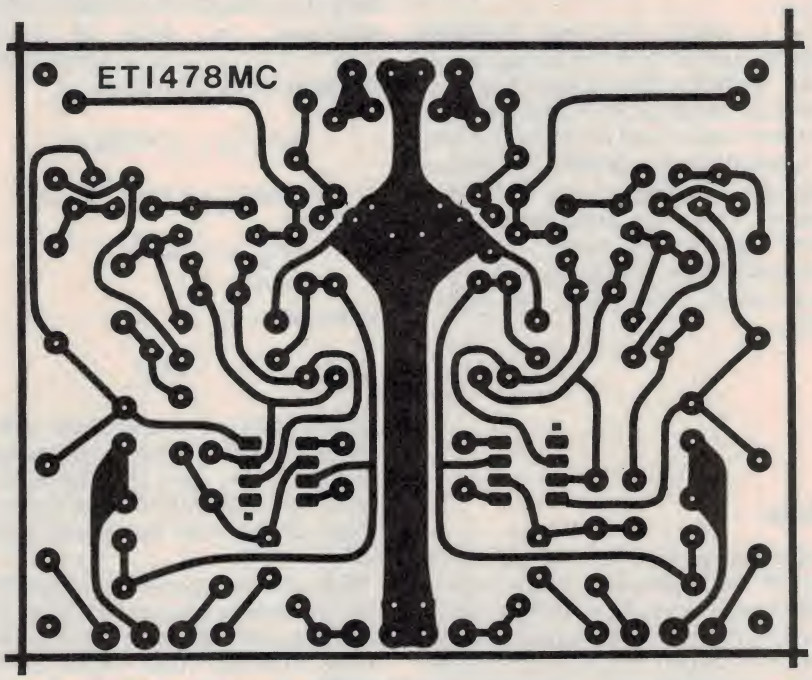


Figure 3. **Typical moving magnet input stage found in medium-priced amplifiers.**

which is equivalent to a 7950 μs time constant. The two remaining time constants are introduced into the negative feedback of IC2 and are formed by the values of resistors R9, R10, R11 and capacitor C6.

This method of generating the RIAA curve offers a number of advantages over the more conventional method.

Firstly there is low interaction between the different time constants, so that the RIAA curve can be optimised for a particular cartridge more easily by changing the resistor or capacitor values slightly. If the 75 μs time constant is included in the negative feedback of a stage, the gain of the stage must decrease to unity at a suitably high frequency, so the stage must be compensated for unity gain to prevent instability. In the Series 5000 MM stage the gain of the second stage does not drop below 10; since the NE5534AN is internally compensated for gains of 3 or above, no additional compensation is required. ▶



Full-size artwork for the moving coil input stage.

Another advantage of the two-stage approach is that the total gain necessary in the MM stage can be divided between the two stages, so more negative feedback is available for each stage. This will have the effect of decreasing non-linearities in the stages, provided the stages conform to the criteria for the avoidance of SID (slew-induced distortion) and amplitude overload. Fortunately, in the case of a phono input stage, both of these are limited by the recording medium. The RIAA standard sets a maximum recording velocity of 25 cm/sec, and most cartridges have output levels around the 1 mV/cm/sec figure. So maximum output levels from such a cartridge will be in the order of 20-30 mV. Even the highest output cartridge produces signal voltages usually in the 5 mV/cm/sec range. Combining a worst case of, say, 5 mV/cm/sec with the maximum allowable recording velocity of 25 cm/sec yields an output voltage of 125 mV. To ensure that the input stage cannot be overloaded we simply set the gain of these stages so that this maximum input signal cannot drive the output of the input stages into clipping. The NE5534AN is capable of driving to within 2 V of the supply voltage, so a supply voltage of ±15 V gives the desired gain of around 75. We have divided this gain between the two input stages so that the first stage has a gain of 8.3 and the second stage a gain of 9 in the midband region (the actual gain of the second stage is of course a function of frequency due to the RIAA equalisation).

As a result the total harmonic distortion of this MM input stage is well under 0.001%. The actual measured distortion using an HP3580A spectrum analyser was around 0.0005% at 1 kHz. (At these distortion levels even the best distortion analysers are practically useless, since the distortion is well below the level of noise.) Similarly, intermodulation distortion (IMD) was measured at well below the 0.001% figure.

Noise

Another very important parameter for both MC and MM input stages is noise performance. Since an op-amp is used as the first stage of the MM input amp, we have only limited control over the noise performance of the stage. It is therefore essential that the op-amp used have excellent noise performance. In order to predict the necessary noise performance for a moving magnet input stage we must look at the sources of noise within the cartridge itself.

It can be shown from the laws of thermodynamics and statistical mechanics that every resistor generates noise. This noise is a result of the way nature works and is not caused by imperfection in a practical resistor (i.e: a perfect resistor will still generate thermal noise). This noise must be added to any signal dropped across the resistance. The equation for thermal noise is:

$$\overline{e_n} = \sqrt{(4kTR\triangle f)}$$

where k = Boltzmann's constant,
T = temperature in absolute units (K)
$\triangle$ = noise bandwidth (brickwall bandwidth)
R = resistance in ohms
$\overline{e_n}$ = average noise voltage

This equation predicts that thermal noise is raised by increasing resistance temperature or the bandwidth of the measuring equipment. So the frequency response of the apparatus used to determine thermal noise must be quoted if the figure is to be meaningful. Furthermore, the $\triangle$f here refers to a 'brickwall frequency response', not the usual half-power bandwidth, although for many purposes this is sufficiently accurate. To overcome this problem noise performance is often quoted in the form of total equivalent input noise and expressed in units of nV/$\sqrt{\text{Hz}}$ (1 nV = 10^{-9} V). This is justified by the equation for thermal noise, i.e:

$$\text{since } \overline{e_n} = \sqrt{(4kTR\triangle f)}$$

$$\text{then } \overline{e_n} = (\sqrt{\triangle f})(\sqrt{(4kTR)})$$

$$\text{or } \frac{\overline{e_n}}{\sqrt{\triangle f}} = \sqrt{(4kTR)}.$$

So the ratio:

$$\frac{\overline{e_n}}{\sqrt{\triangle f}}$$

depends only on temperature and resistance, and this is just what we want. In order to get from this figure to an actual total equivalent noise figure we simply multiply by the square root of the bandwidth.

Most moving magnet cartridges have a coil resistance around 500 ohms. This resistance will generate thermal noise, so the cartridge itself limits the best possible signal-to-noise ratio. Using the equation for thermal noise we obtain for the noise of the cartridge:

$$\overline{e_n} = \sqrt{(4 \times 1.37 \times 10^{-23} \times 290 \times 500)} \text{ Hz}$$

(assuming temperature of resistor is ≑ 290K).

$$\text{i.e: } \frac{\overline{e_n}}{\sqrt{\text{Hz}}} = 2.8 \times 10^{-9}$$

$$\text{i.e: } \overline{e_n} = 2.8 \text{ nV}/\sqrt{\text{Hz}}.$$

We can express this in more familiar terms by converting the cartridge noise figures into a signal-to-noise ratio figure. In audio we can regard the bandwidth in question to be around 20 kHz, i.e: $\sqrt{\triangle f} = 140$, and 140 x 2.8 nV/$\sqrt{\text{Hz}}$ = 392 nV. If the average output level of the cartridge is around 5 mV, the signal-to-noise ratio is given by:

$$20 \log \frac{5 \times 10^{-3}}{392 \times 10^{-9}} \div 82 \text{ dB}$$

This figure represents the best signal-to-noise ratio possible with most moving magnet cartridges, since this is due to noise generated within the cartridge itself. A well-designed input stage should approach this noise figure as closely as possible without sacrificing performance in other equally important parameters such as distortion and frequency response.

The noise generated by an active device is determined by a number of factors, the most important of which is the current flowing through the device. However, since we have elected to use a high-quality operational amplifier for the input stage, we have no control over device current. All we can do is choose a low-noise op-amp and avoid degrading its noise figure as much as possible. The NE5534AN has a recommended equivalent input noise voltage around 4 nV/$\sqrt{\text{Hz}}$, only 3 dB above the noise generated by the cartridge itself! In order not to degrade this figure we must keep all resistances in series with the cartridge as low as possible. Any additional resistance will generate a thermal noise voltage of its own, which must be added vectorally to that generated by the cartridge. From the basic equation of thermal noise generated by two individual resistors R_1 and R_2, for example, we obtain:

$$\overline{e_{n1}} = \sqrt{(4kTR_1\triangle f)} \text{ and}$$
$$\overline{e_{n2}} = \sqrt{(4kTR_2\triangle f)}$$

Here we assume that both resistances are at the same temperature. Since these noise voltages are not correlated (i.e: they consist of 'randomly' changing voltage) we add them using the vector sum:

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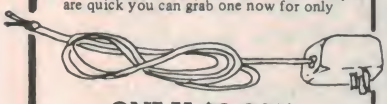

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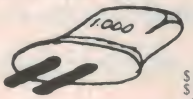

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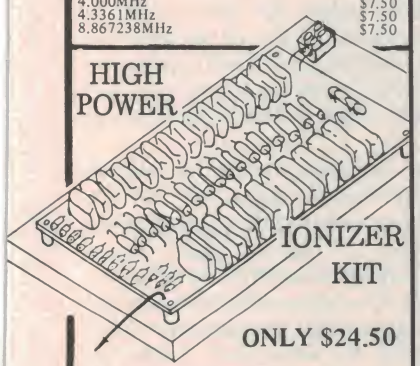

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4007AE	0.38	0.20
4012AE	0.35	0.20
4018AE	1.50	0.50
4023AE	0.28	0.15
4024AE	1.18	0.50
4026AE	2.20	1.00
4027AE	0.90	0.50
4028AE	1.18	0.50
4029AE	1.25	0.55
4033AE	1.50	0.50
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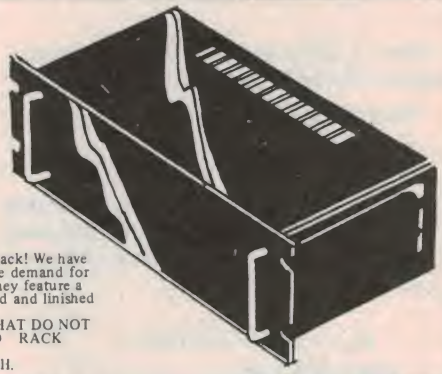

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- Equalisation on each input
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P&P $5 - $5.99: $1.00; $10 - $24.99: $2.00; $25 - $49.99: $3.00; $50 - $99.99: $4.00

i.e: $\overline{e_{nT}^2} = \overline{e_{n_1}^2} + \overline{e_{n_2}^2}$

where $\overline{e_{nT}^2}$ is the square of the total equivalent noise voltage.

Therefore $\overline{e_{nT}^2} = 4kT\triangle f(R_1 + R_2)$

or $\overline{e_{nT}} = \sqrt{(4kT\triangle f(R_1 + R_2))}$.

If R_1 now represents the cartridge resistance and R_2 the value of an added resistance equal to the value of R_1, we get:

$$\overline{e_{nT}} = \sqrt{(4kT\triangle f(2R_1))} = \sqrt{2}\sqrt{(4kT\triangle fR_1)}$$

$$\text{or } \overline{e_{nT}} = 1.4\overline{e_{nT}},$$

equivalent to a 3 dB decrease in the signal-to-noise ratio.

Figure 4 shows the standard technique for connecting an op-amp to a signal generator such as a moving magnet cartridge. Most op-amps, and certainly the 5534, have input stages that consist of a differential pair, providing both inverting and non-inverting inputs.

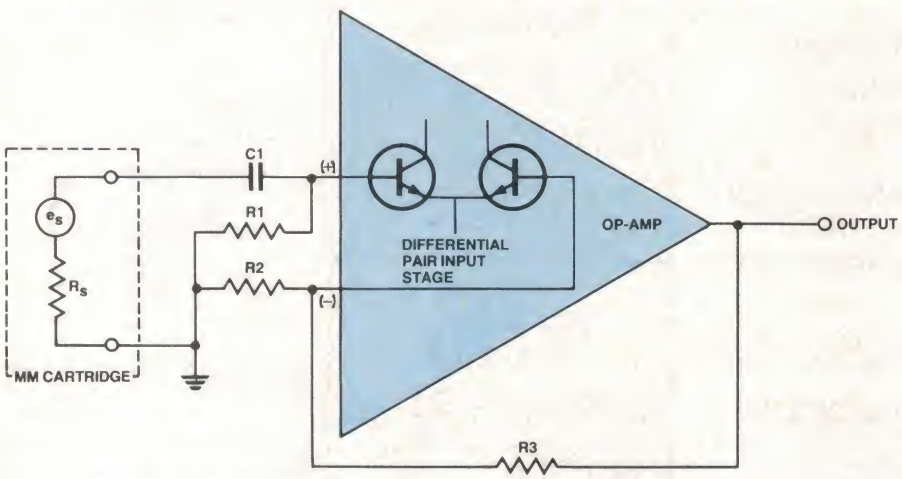

Figure 4. **Standard technique for connecting an op-amp to a signal source.**

The effective signal voltage generator of the cartridge is represented by e_s and the cartridge resistance by R_s. Resistor R1 in this case would be 47k, so that the cartridge would have the correct load resistance. (The input impedance of the op-amp is very high and can be ignored for this discussion.) Capacitor C1 prevents any dc current flowing through the cartridge from the non-inverting input. Since the combination of R1 and C1 forms a 6 dB/octave high-pass filter, the value of C1 would ordinarily be chosen so that the resulting −3 dB point was well below the audio spectrum, around 5 Hz for example. This will occur when the impedance of C1 is equal to that of R1, i.e: 47k. Since the reactance of the capacitor is given by the equation:

$$X_c = \frac{1}{2\pi fC}$$

we have:

$$C = \frac{1}{2\pi fX_c}$$

$$\text{In this case } C = \frac{1}{2\pi \times 5 \times 47 \times 10^3}$$

$$\div 6.77 \times 10^{-7} \text{ Farads.}$$

So to obtain an adequately flat frequency response a suitable value for C1 would be 680 nF (0.68μF), which is convenient since a greencap could be used.

When noise considerations are taken into account, however, this value is entirely unsuitable. The increasing impedance of C1 at low frequencies, while not sufficient to cause gross frequency response errors, will seriously degrade the noise performance of the stage. At sufficiently low frequencies the impedance seen by the non-inverting input will be simply the value of R1. Using the equation for thermal noise given earlier, we can calculate the resulting signal-to-noise ratio. Since

$\overline{e_n} = \sqrt{(4kT\triangle fR_1)}$,

$\overline{e_n} = \sqrt{(4 \times 1.37 \times 10^{-23} \times 290 \times 20 \times 10^3 \times 47 \times 10^3)} = 3.87\ \mu V$,

only 62 dB below 5 mV.

Furthermore, since the input stage is a noise generator, a low source impedance is necessary to minimise the resulting noise at the output of the op-amp. To overcome this problem we increase the value of C1 so that at worst its impedance at, say, 3 Hz is comparable to that of the cartridge, i.e:

$$C = \frac{1}{2\pi \times 3 \times 500} = 106 \times 10^{-6}\text{F}.$$

So a value around 100 μF should suffice. Notice that this capacitor would have to be an electrolytic or tantalum. Tantalum capacitors are not recommended, however, since their capacitance can be modulated by the input signal, producing considerable distortion at low frequencies.

The value of resistor R2 must also be low, so that the source impedance to the inverting input of the op−amp can be kept as low as possible. The limitation here is due to the minimum load impedance allowable on the output of the op-amp. Since the gain of the stage is given by the equation:

$$A_v = \frac{R2 + R3}{R2},$$

the ratio of R2 and R3 is determined by the desired voltage gain. At the same time, however, the total resistance R2 + R3 represents the load on the output stage of the op-amp. Since this must not be less than a certain specified resistance, determined by the individual op-amp used, a minimum value for R2 is predicated. In the Series 5000 MM input stage, for example, the required voltage gain in the first stage is around 8.3, so:

$$\frac{R2 + R3}{R2} = 8.3$$

The NE5534AN has a measured minimum load impedance of 600 ohms, and for minimum distortion it is desirable to increase this slightly, for example to around 1k2. Therefore:

$$\frac{1k2}{R2} = 8.3 \text{ or } R2 \div 144R$$

A suitable value for R2 would be 120 ohms, making R3 1k to give the required voltage gain. Fortunately this value for R2 is low enough not to have significant effect on the noise performance.

Similar measures must be adopted around the second stage. At low frequencies the non-inverting input of IC2 (see Figure 1) has an input source resistance determined by R7 and R8, i.e: around 8k. The noise performance of the second stage would be improved if this value could be decreased. Unfortunately this would entail increasing the value of C4, which is not practical since this capacitor must be a greencap if the preamp is to conform accurately to the RIAA curve. This is not really a problem, however, since the voltage gain in the first stage increases the signal voltage at the input of IC2 to around 40 mV for a 5 mV input signal, ensuring a sufficiently good signal-to-noise ratio in the second stage. ▶

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You can have a SuperFinish front panel for your amp for only $49.50 or just $10 on top of our regular kit price of $289 – $299 total.

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The moving coil input stage

The subject of noise performance is particularly important for a moving coil input stage. The moving coil cartridge works on exactly the same principle as the moving magnet. The signal voltages produced are the result of relative motion between a coil of wire and a magnetic flux. In this case, however, the magnet assembly is mounted rigidly to the cartridge body and the coils are mounted on the cantilever assembly; hence the name 'moving coil'.

In order for the total mass and therefore the inertia of the stylus/cantilever system to be kept to a minimum, the coils are made with very fine wire and a small number of turns. Typical output voltages for moving coil cartridges vary widely from one manufacturer to another, but a figure of 40 μV/cm/sec is probably a reasonable compromise. A gain of 25 is therefore required to boost this voltage to that of a typical moving magnet cartridge. Once again we can calculate the best possible signal-to-noise ratio for a moving coil cartridge based on its thermal noise. The coil resistance of a moving coil cartridge with an output of 40 μV/cm/sec would be approximately 20 ohms (although this figure can vary widely, typcially 5-50 ohms).

From the equation for thermal noise we obtain:

$$\frac{\overline{e_n}}{\sqrt{Hz}} = \sqrt{(4kTR)},$$

$$\text{i.e: } \frac{\overline{e_n}}{\sqrt{Hz}} = \sqrt{(4 \times 1.37 \times 10^{-23} \times 290 \times 20)}$$

$$\doteqdot 0.56 \text{ nV}/\sqrt{Hz}.$$

The total noise over a 20 kHz noise bandwidth is therefore:

$$0.56 \text{ nV} \times \sqrt{(20 \times 10^3)}$$

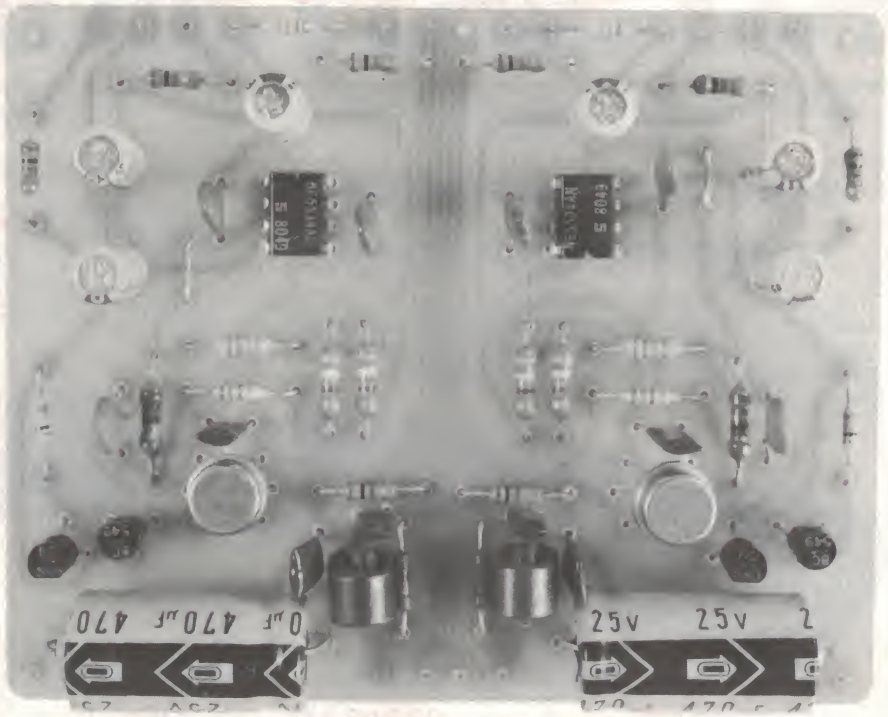
$$\text{i.e: } 0.56 \text{ nV} \times 140 \doteqdot 78 \text{ nV}.$$

Since the cartridge output voltage will be around 40 μV/cm/sec x 5 cm/sec, i.e: 200 μV for a recording velocity of 5 cm/sec, the resulting signal-to-noise ratio will be:

$$20 \log \frac{200 \times 10^{-6}}{78 \times 10^{-9}}$$

or around 68 dB unweighted.

This figure is only approximate, of course, but it is roughly correct and represents the best possible signal-to-noise ratio with a moving coil cartridge. The object is to design a preamplifier that will approach this noise figure and maintain a flat frequency response, low distortion and a constant resistive input impedance. At these noise levels we cannot use an NE5534AN in a circuit like the MM input stage. The total equivalent input noise in that case was around 4 nV/$\sqrt{Hz}$, i.e: 560 nV. The resulting signal-to-noise ratio would be only 51 dB with respect to an input signal of 200 μV.



The completed moving coil input stage (ETI-478MC). Note that this project could be used 'stand-alone' as an MC head amp.

In order to achieve a satisfactory noise performance it is necessary to look at the various sources of noise in bipolar transistors and decrease the total equivalent input noise through optimum biasing of the input stage and choice of the first transistor.

One source of noise in the transistor is of course thermal noise. We saw before that to minimise thermal noise it was necessary to ensure a low source resistance over as broad a frequency range as possible. In order to do this for the MC stage the total resistance in series with the source must be kept to a similar value to the source resistance, i.e: around 10 or 20 ohms, depending on the cartridge.

The problem is that the resistance of the base-emitter junction of most bipolar transistors, called the base spreading resistance, is usually much higher than this. One solution is to use a large number of low-noise transistors in parallel to form the input transistor, thus decreasing the base spreading resistance. This was the technique used in the Series 4000 moving coil preamp, published in ETI October 1979. Another solution is to use a power transistor, such as a 2N3055, as the input transistor, and the results using this method can be quite good! The third alternative, and the one we elected to use in this design, is to make use of an exceptional matched pair produced by National Semiconductor. This device, the LM394, has a low base resistance, very low noise and a high h_{FE} of around 500. (A data sheet for the LM394 will be included in next month's article).

Another source of noise in bipolar transistors is shot noise or base current noise. This is a white noise generator (i.e: the average amplitude of the noise current is constant with frequency), but the noise is increased if emitter current is increased. The base resistance, however, is also a function of the current flowing in the emitter, and is given roughly by the equation:

$$r_b = \frac{26}{I_{E(mA)}}.$$

The resistance of the base *decreases* with increasing emitter current, so noise voltage produced by thermal noise across the base resistance is decreased by increasing the emitter current. In a bipolar transistor, therefore, we have two distinct sources of noise, one increasing with emitter current while the other decreases. For this reason an optimum emitter current exists which represents the best compromise between these two noise sources. With an LM394 operated from source resistances typical of moving coil cartridges, the optimum emitter current is around 8 mA, much higher than would normally be used in an input stage. The result, however, is a very low

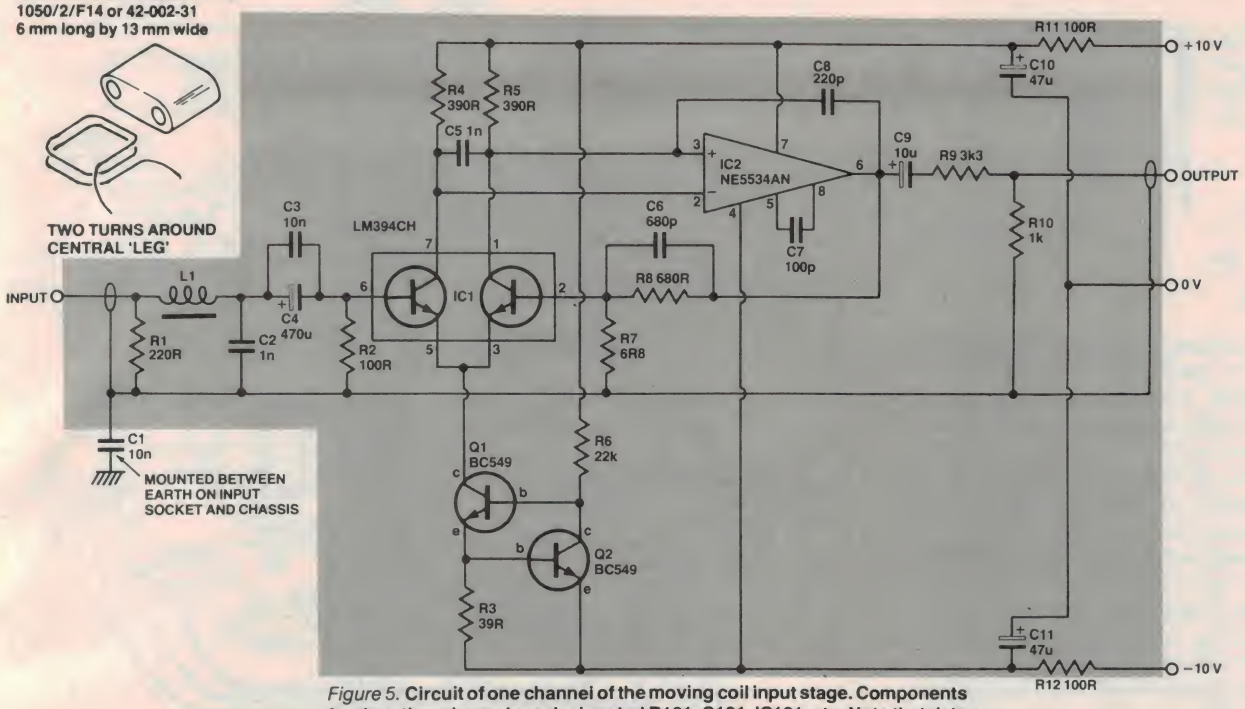


Figure 5. **Circuit of one channel of the moving coil input stage. Components for the other channel are designated R101, C101, IC101, etc. Note that data for the LM394 and NE5534 devices are included at the end of this article.**

value of input noise for source resistances around 10 ohms.

The complete circuit diagram for the moving coil input stage is shown in Figure 5. The collectors of the LM394 are connected to the input of an NE5534, which functions as a high-gain differential amplifier, providing adequate open loop gain to ensure low distortion and a flat frequency response when negative feedback is applied. The input choke is used to minimise the stage's susceptibility to RF noise.

The input impedance of the stage is determined by the parallel combination of R1 and R2, around 65 ohms for the values shown. This should be suitable for most moving coil cartridges, but is easily changed if required. The dc operating point of the LM394 is determined by the constant current source formed by Q1, Q2, R3 and R6. So the current in resistor R2 is determined by this constant current source and the dc current gain of the LM394. Hence the value of R2 can be increased, in order to increase the input impedance, over a fairly wide range of values without affecting the operation of the circuit.

Once again the input coupling capacitor C4 is used to prevent dc current from flowing through the cartridge. Capacitor C4 is shunted by C3, a 10n capacitor, so that the base of the first transistor in the LM394 is decoupled for RF, through C2. Capacitor C2 represents a shunt capacitance to ensure correct loading of the moving coil cartridge. The value shown should be suitable for most cartridges, but can be changed for optimisation with any particular cartridge.

To prevent loading the 5534A, the feedback resistor R8 is kept above 600R, i.e: 680R. Resistor R7 effectively increases with the cartridge and must be kept as low as possible for best noise performance. The value of 6R8 chosen gives the stage a gain of around 100, which is too high. This is corrected, however, by a simple passive voltage divider at the output, formed by R9 and R10. Capacitor C9 doubles as a feedback isolation capacitor to ensure that reactive components in the load cannot cause a phase shift sufficient to cause oscillation. ▶

HOW IT WORKS ETI-478MC

The input from a moving coil cartridge is fed via L1 and capacitors C3 and C4 to the base of one of the transistors in the LM394, which functions as a differential input stage.

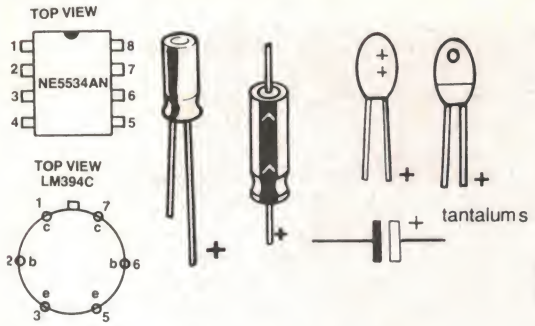
Q1 and Q2 form a constant current source, which stabilises the dc operating point and ensures a high impedance source to the emitters of the differential pair. The constant current source works by ensuring that a constant voltage is maintained across a fixed value of resistance. Resistor R3 is used for this purpose, with the base emitter voltage of Q2 expressed across it. If the current through R3 were to try to increase even slightly, the voltage on the base of Q2 would be increased, turning Q2 on harder. This causes the voltage on the collector of Q2 to decrease, decreasing the current through R3. So Q2 provides negative feedback acting to correct any deviations in the current flowing through the differential pair.

The collectors of the LM394 are shunted by the 1n capacitor C5. This decreases the gain of the first stage at high frequencies and helps to ensure stability (i.e: freedom from high frequency oscillations).

The input stage is operated in full differential mode by connecting both collectors to inputs of the NE5534AN. If this is not done the voltage gain of the input stage is decreased and the signal-to-noise ratio is degraded. Because differential pairs have two base-emitter junctions in the input circuit, their total equivalent input noise is inferior to that of a single transistor. However, since it is possible using a differential pair to obtain noise figures of the same order of magnitude as the thermal noise of the cartridge, the marginal decrease in the theoretically best signal-to-noise ratio is of little consequence. On the other hand the inherent linearity of a differential pair offers a significant advantage over a single transistor, improving both distortion and high frequency stability.

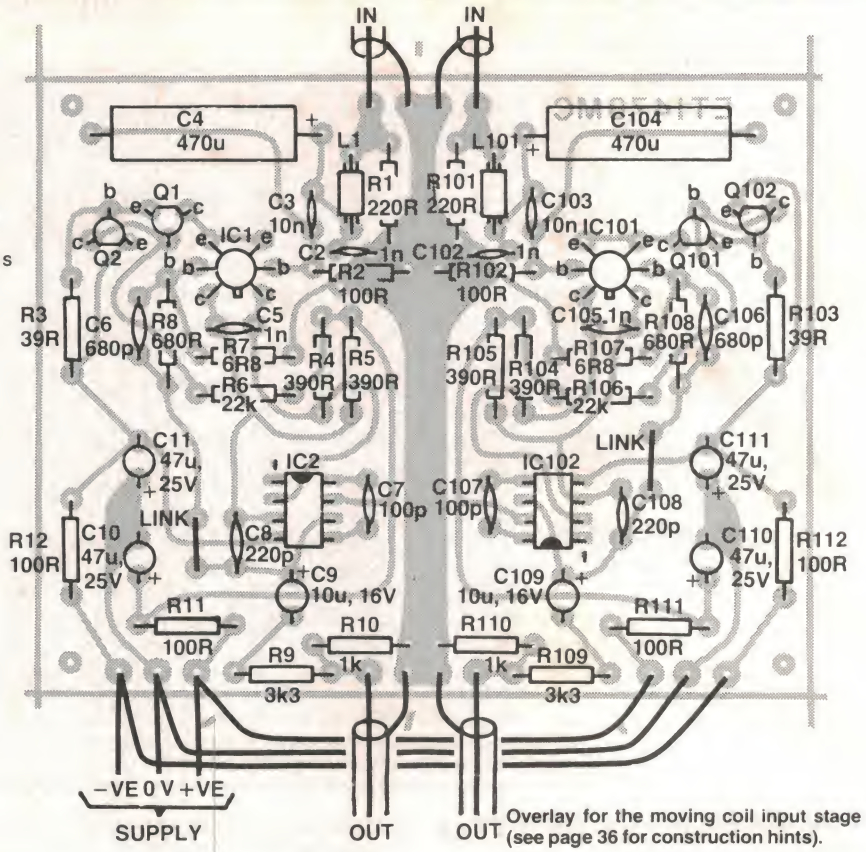
Capacitor C7 ensures stability of the op-amp by providing adequate compensation for the increased gain around the stage due to the differential pair. C9 provides dc isolation of the stage. The resistors R9 and R10 form a potential divider to decrease the signal level to that suitable for the MM input. If the particular moving coil cartridge used requires a different amount of voltage gain than is provided, the value of R9 can be changed accordingly. Replacing R9 with a short circuit (i.e: a piece of tinned copper wire in place of the resistor on the circuit board) increases the voltage gain of the stage to slightly over 100.

The two RC networks R11, C10 and R12, C11 provide isolation of the supply voltage from other stages using the same power supply. This decreases interactions between stages, thereby improving crosstalk and the overall stability of the preamplifier.



The noise performance of the stage is extremely good. The total equivalent input noise was measured at 83 nV over a 20 kHz noise bandwidth. This is equivalent to 0.6 nV/√Hz or a signal-to-noise ratio of 68 dB with respect to an input signal voltage of 200 μV. This might sound like only an average noise figure compared to that attainable with the moving magnet preamp, but it should be remembered that the noise generated by the cartridge itself is of this order of magnitude!

Another point worth mentioning here is that all the noise figures quoted so far in this article are flat or unweighted measurements. This means that the measurement was carried out with a noise and distortion analyser with a flat frequency response over the quoted noise bandwidth, usually 20 kHz. This is convenient and meaningful for the analysis of electrical circuits so long as the frequency distribution of the noise is also known. Probably the most useful way to quote noise figures at audio frequencies, however, is to graph noise circuits of nV/√Hz against frequency. The problem with flat noise measurements is that the human hearing mechanism does not detect all frequencies with equal sensitivity. For example, a noise generator with a high average noise voltage in the 1 kHz to 5 kHz region will be perceived as 'noisier' than one with an identical unweighted noise measurement but with higher average noise voltage in the 100 Hz to 1 kHz band. To overcome this problem the frequency response of the measured equipment can be modified to accent or 'weight' the appropriate frequency bands. The most common weighting curve used in audio measurement is shown in Figure 6. The use of A-weighting gives a better indication of the apparent loudness of a noise voltage than do unweighted ('flat') measurements, and this is the reason almost all manufacturers quote A-weighted noise figures. A-weighted noise measurements for the Series 5000 MM and MC stages are quoted with specifications elsewhere in this article.



Overlay for the moving coil input stage (see page 36 for construction hints).

ETI-478MC PARTS LIST FOR STEREO PC BOARD

Resistors ..... all ¼W metal film, 5% unless noted otherwise

R1,R101 ..... 220R
R2,R102,R11, R111,R12,R112 ... 100R
R3,R103 ..... 39R
R4,R104,R5,R105 . 390R
R6,R106 ..... 22k
R7,R107 ..... 6R8
R8,R108 ..... 680R
R9,R109 ..... 3k3
R10,R110 ..... 1k

Capacitors

C1,C101,C3,C103 . 10n greencap
C2,C102,C5,C105 . 1n greencap
C4,C104 ..... 470u 16 V electrolytic
C6,C106 ..... 680p ceramic
C7,C107 ..... 100p ceramic
C8,C108 ..... 220p ceramic
C9,C109 ..... 10u 16 V electrolytic
C10,C110, C11,C111 ..... 47u 25 V electrolytic

Semiconductors

Q1,Q101,Q2,Q102 . BC549

Integrated circuits

IC1, IC101 ..... LM394CH
IC2, IC102 ..... NE5534AN

Miscellaneous

L1 ..... Two turns on ferrite balun core, Neosid type 1050/2/F14 or 42-002-31

ETI-478MC pc board; shielded cable; assorted mounting hardware, etc.

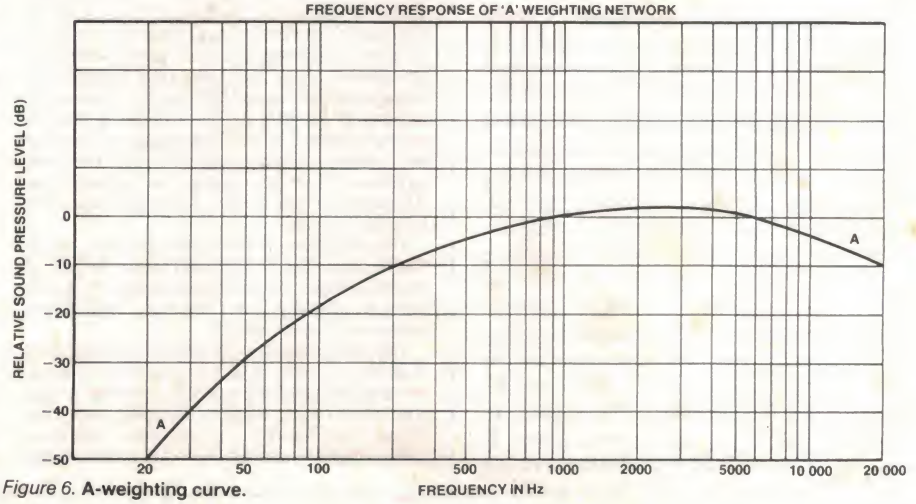


Figure 6. **A-weighting curve.**

Construction

Construction of both boards is relatively straightforward, since almost all the components are mounted on the pc boards. Resistor R1 and capacitor C1 on the moving magnet board are intended to be mounted directly across the back of the input socket. Order of construction is not critical, although it is probably easier to mount small components first, followed by the larger components such as the electrolytic capacitors and IC1. Be careful to watch the orientation of the electrolytic capacitors, ICs and transistors; these components will be damaged if the unit is powered up with them inserted incorrectly. Shielded cable should be used on all inputs and outputs. We have used mono shielded cable rather than the stereo type for ease of soldering.

Each of the pc boards is a stereo input amplifier, with each channel sharing a common input earth track running down the centre of the board. The power supply wiring from each channel on the MC board can be connected in parallel, so only three wires (+, 0, −) need to be brought out for power to the MC amp. The MM board is similar, but the power supply wiring for the two boards should be kept separate, since they run from slightly different supply voltages. If you are using these boards in a different application to that of the Series 5000 preamp and wish to run both boards from the same supply voltage (i.e: 15 V-0-15 V), the value of resistors R11 and R12 on the MC board should be increased to around 270R, to decrease the power dissipation on the LM394.

The input earth is *not* connected to the 0 V line from the power supply at any place on the pc boards. This means that without a separate 0 V connection added to the input stage they will *not* work. This has been done deliberately to ensure that hum present on the earth line, due to supply bypass capacitors for example, cannot modulate the signal earth, producing hum in the output. The 0 V line on the pc boards is in fact a separate supply bypass earth line and is not equivalent to the signal earth. Full details of the signal earth connections will be given in Part 3 of this series of articles. For the purpose of testing the stage, however, a separate wire should be run from the centre point (0 V point) of the power supply used to the signal earth at the input sockets.

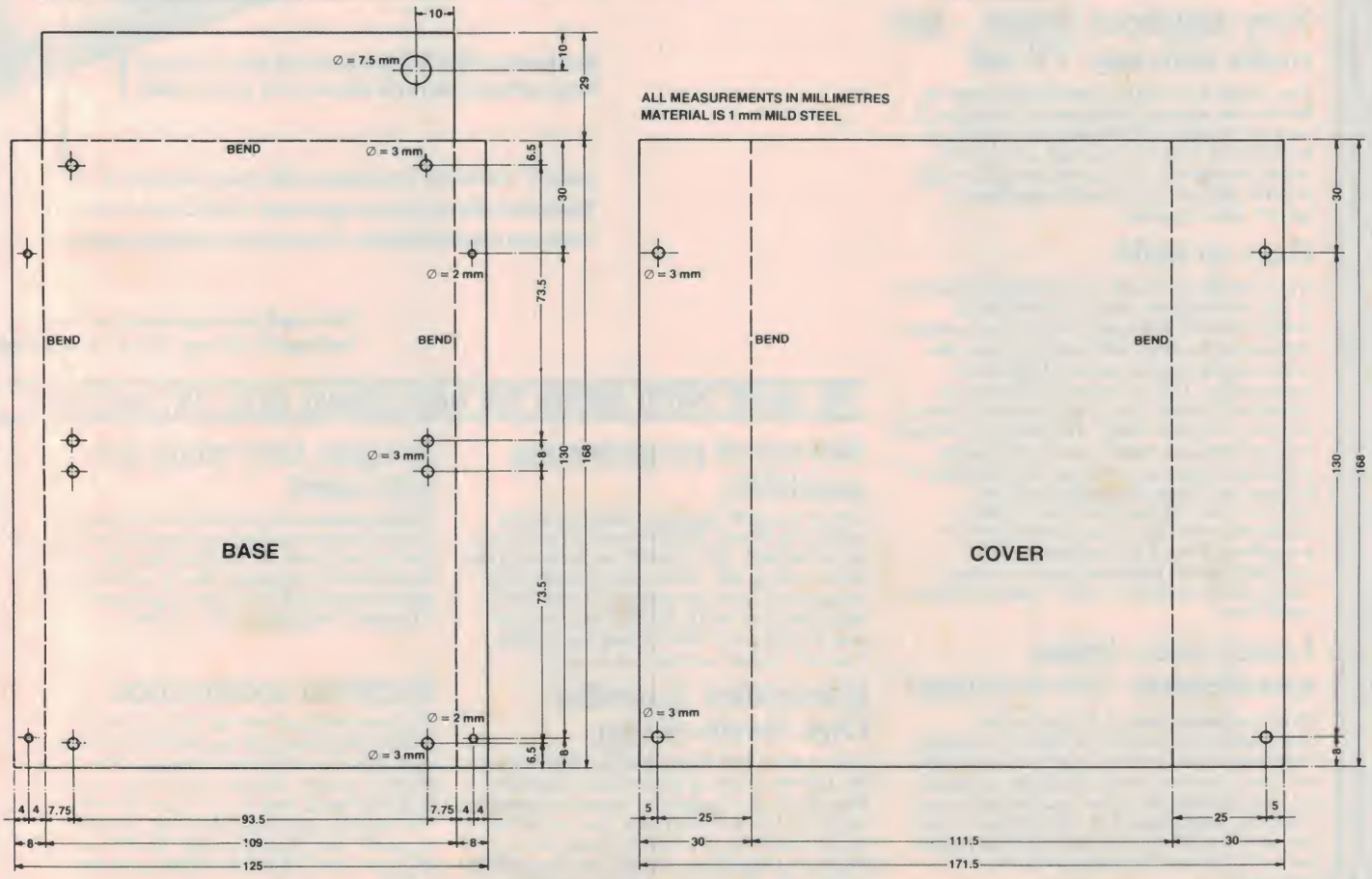
Both boards should be mounted in a *steel* box which can be mounted as a unit inside the main preamp chassis. This greatly improves the rejection to 50 Hz magnetic fields generated by nearby power transformers or 240 V cables. Details of the metalwork for this box are included with this article. Note that one end is left open to facilitate easy entry and exit of the shielded cable and power supply wiring. The MC stage should be mounted at the closed end of the box with its input end closest to the steel end panel. The input to the MC amp should be made through a small hole in this end of the box (see photo, p.24). The MM board is mounted closer to the open end, again with its input end pointing towards the solid end panel of the box (i.e: adjacent to the MC output).

Powering up

No setting-up procedure is required for either stage, but make a final check of all components before applying power to the unit. After a few minutes' operation the LM394s should be reasonably warm. These devices dissipate around 160 mW, so some heating should be expected. Similarly the NE5534s run slightly above ambient temperature. ●

(Next month we continue with the high level stages, completing the construction and data for the LM394 and NE5534s.)

Metalwork details for the low-level stages' shielding box. It may be constructed from tinplate or 1 mm galvanised mild steel plate. It *must be steel* to provide shielding from magnetically induced hum fields, such as from power transformers, turntable motors, etc.



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elay to operate cassette unit automatically

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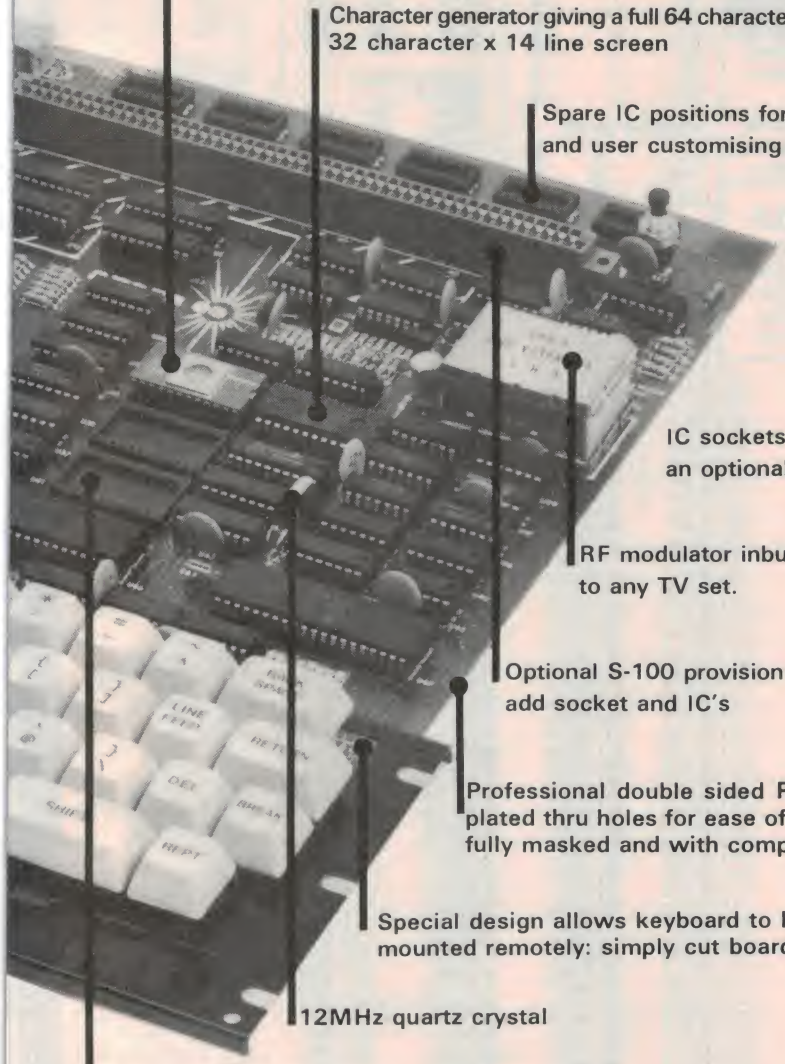

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amous Z-80 microprocessor as used in andy & System 80 computers

*Copy of articles will be included when available from EA.

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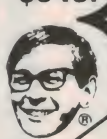

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7474	.60
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7480	.65
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7483	.80
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9312	1.35
74156	1.50
74157	.60
74161	1.00
74162	1.00
74163	.85
74164	.60
74165	.60
74174	.50
74175	.90
74176	1.10
74177	1.10
74180	.90
74181	2.30
74182	.90
74184	1.20
74185	1.20
74190	1.00
74191	1.50
74192	1.70
74193	.80
74194	1.10
74195	.65
74196	.85
74197	1.10
74198	1.10
74199	1.30
74221	.90
74290	.90
73293	.90
74365	.80
74366	.80
74367	1.00
74368	1.00
8T96	1.80
9314	1.30
9368	1.75
9370	2.00

74LS SERIES

74LS00	.40
74LS01	.40
74LS02	.40
74LS03	.40
74LS05	.40
74LS08	.40
74LS09	.40
74LS10	.40
74LS11	.40
74LS13	.50
74LS14	.90
74LS15	.40
74LS20	.40
74LS21	.40
74LS22	.40
74LS26	.40
74LS28	.40
74LS30	.40
74LS32	.40
74LS33	.40
74LS37	.50
74LS38	.50
74LS40	.50
74LS42	.75
74LS47	.85
74LS48	1.00
74LS49	1.00
74LS51	.40
74LS54	.50
74LS55	.55
74LS58	.65
74LS73	.55
74LS74	.60
74LS75	.45
74LS76	.50
74LS78	.50
74LS83	1.00
74LS85	1.00
74LS86	.50
74LS90	.70
74LS92	.90
74LS93	.80
74LS95	.65
74LS96	1.55
74LS107	.60
74LS109	.60
74LS112	.60
74LS113	.65
74LS114	.50
74LS122	.50
74LS123	.75
74LS125	.50
74LS126	.70
74LS132	.80
74LS133	.50
74LS136	.50
74LS138	1.20
74LS139	.85
74LS151	.75
74LS153	.60
74LS154	1.50
74LS155	1.00
74LS156	1.00
74LS157	.90
74LS158	.70
74LS160	.85
74LS161	.85
74LS162	1.00
74LS163	.85
74LS164	1.30
74LS165	.50
74LS168	1.90
74LS169	1.90
74LS170	2.80
74LS173	.90
74LS174	.90
74LS175	.90
74LS181	2.50
74LS189	3.80
74LS190	1.30
74LS191	1.10
74LS192	.85
74LS193	.85
74LS194	.70
74LS195	.80
74LS196	1.25
74LS197	1.00
74LS221	1.10
74LS245	2.35
74LS247	.90
74LS249	1.30
74LS251	.80
74LS253	.90
74LS257	.65
74LS258	.50
74LS259	2.45
74LS260	.90
74LS266	.90
74LS273	1.60
74LS279	.65
74LS283	1.15
74LS290	1.10
74LS293	1.15
74LS295	1.60
74LS298	1.00
74LS352	1.30
74LS353	1.30
74LS365	.50
74LS366	.70
74LS367	.90
74LS368	.90
74LS373	1.50
74LS374	1.70
74LS386	.50
74LS670	2.70
81LS95	2.10
95H90	11.50
11C90	19.50
81LS96	2.10
81LS97	2.10

TRANSISTORS

2N301	2.20
2N657	.60
2N930	.60
2N1613	1.10
2N1711	.50
2N1893	1.00
2N2219A	.60
PN2222	.20
PN2222	.30
2N2463	.35
2N2484	.65
2N2646	.70
2N2647	1.10
2N2894	.80
2N2904	.45
2N2905	.40
2N2906	.45
2N2913	1.20
PN2907	.30
2N3053	.60
2N3054	.90
2N3055	.90
2N3301	.40
2N3440	1.10
2N3502	.70
2N3503	.70
2N3563	.30
2N3564	.30
2N3569	.30
PN3565	.30
PN3566	.30
PN3567	.30
2N3568	.30
2N3638	.30
2N3639	.30
2N3640	.30
2N3641	.30
2N3645	.30
PN3642	.30
PN3643	.30
PN3644	.30
2N3646	.30
2N3692	.50
2N3693	.35
2N3702	.30
PN3694	.30
2N3704	.30
2N3709	.30
2N3713	2.20
2N3819	.80
2N3866	2.00
2N3904	.30
2N3906	.30
2N4030	1.10
2N4032	.55
2N4033	.90
2N4036	1.00
2N4037	.90
PN4121	.30
2N4233	1.60
2N4235	1.90
2N4236	2.20
2N4248	.30
PN4249	.30
2N4250	.30
2N4258	.30
2N4292	.70
2N4354	.30
2N4355	.30
2N4356	.30
2N4398	5.00
2N4401	.50
2N4402	.50
2N4403	.50
2N4416	1.00
2N4906	2.80
PN4868	.30
2N5088	.30
2N5089	.30
2N5179	1.90
2N5303	3.30
2N5320	.80
2N5401	.30
2N5458	.70
2N5459	.70
2N5461	.70
2N5484	.70
2N5485	.70
2N5486	.70
2N5769	.30
2N5770	.25
2N5830	.25
2N5831	.30
2N5856	.30
2N5873	1.10
2N5874	1.40
2N5961	.30
2N5963	1.10
2N6027	.60
3N201	.90
AC127	.70
AC128	.70
AC187	.70
AC188	.70
AD149	2.50
AD161	1.70
AD162	1.70
BC318	.30
BC319	.18
BC327	.15
BC328	.30
BC337	.30
BC338	.30
BC547	.15
BC548	.15
BC549	.15
BC549C	.40
BC557	.16
BC558	.16
BC559	.16
BC637	.25
BC638	.36
BC639	.40
BC640	.40
BCY70	.85
BCY71	.85
BD115	1.50
BD135	.70
BD136	.70
BD137	.70
BD138	.70
BD139	.70
BD140	.70
BD235	.65
BD234	.50
BD237	.50
BD262	1.20
BD301	.75
BD302	.75
BD263	1.25
BD435	.75
BD646	1.70
BD647	1.80
BD675	.80
BDV64B	4.50
BDV65B	4.50
BF115	.50
BF173	.70
BF180	.70
BF195	.30
BF198	.30
BF199	.30
BF336	.80
BF337	.80
BF458	.90
BF494	.40
BFX85	.75
BFY50	.90
BFY90	1.30
BSV17	1.00
BU126	3.00
BU208	3.00
BUX80	7.90
FT2955	1.40
FT3055	.75
MEL12	.90
BU326A	3.40
MJ2955	1.00
MJ4032	7.40
MJ802	3.40
MJ4035	6.90
MJ4502	3.70
MJE340	1.20
MJE350	1.70
MJE295	1.90
MJE8055	1.90
MJE3521	.60
MJ15003	4.00
MJ15004	4.00
QF102	.60
MPF131	1.40
MPSA05	.60
MPSA06	.60
MPSA12	.60
MPSA14	.60
MPSA42	.60
MPSA56	.80
MPSA92	.60
MRF475	4.40
TT31B	.90
TI3PIC	1.00
TIP32B	.90
TIP32C	1.00
TIP33A	1.10
TIP34A	1.20
TIP24B	1.50
TIP42B	1.10
TIP110	1.30
TIP120	1.80
TIP2955	1.50
TIP3055	1.50
VN88AF	2.50

MICRO CHIPS

ADCO 800	12.00
DACO 080	2.00
2012 200 NS	2.00
2102 350 NS	2.00
2102 450 NS	1.40
2102 650 NS	1.40
2111	8.60
2114 150 NS	11.15
2114 300 NS	3.90
2114 450 NS	3.50
8-31	3.30
32 up	3.10
2513	14.50
2516	55.00
2532	69.00
2650	23.00
2708	8.50
2716	12.00
4116	5.50
5101	9.00
MM5204	12.50
MM5220	7.20
MM5307	18.00
MM5309	6.50
MM5312	9.00
MM5369	2.60
5387	8.50
MM5395	6.50
6502	10.50
6508	5.50
6520	5.50
6522	10.00
6523	17.00
6551	17.00
MC6900P	9.00
MC6802	13.60
MC6808	12.50
6810A	4.90
6820	5.50
6821	6.00
6850	5.15
6852	6.40
7106	12.60
7107	15.00
7210	13.20
Z80 CPU	14.00
Z80A CPU	16.00
Z80 P10	13.80
Z80A P10	16.50
Z80 CTC	13.80
Z80A CTC	16.50
Z80 DMA	40.70
Z80 S10/0	56.90
Z80 S10/1	56.90
Z80 S10/2	56.90
Z80A S10/0	63.00
Z80A S10/1	63.00
Z80A S10/2	63.00
8035	27.00
INS8050	15.00
INS8080	8.00
P8085	25.00
8155	22.00
8165	22.00
8205	5.00
P8212	4.00
8214	8.00
8216	5.90
8224N	5.50
8224	7.50
8226	5.90
8228	9.50
8238	8.00
8243	8.00
8251	14.00
INS8251	6.50
8253	19.50
8255A	8.60
8257	99.00
8259	99.00
8275	99.00
8278	99.00
8295	25.00
DM8578	3.50
Ay-5-2376	19.56
MM5104N	10.00
MM55106N	10.00
MM57160	7.50
8748A	99.00
8755A	99.00
MCT2	.80
MCT6	3.30
MCT275	1.50
MCC671	3.00
4N28	.85
4N33	1.20
4N26	.85
MM80C95	.90
80C96	.90
MM80C97	.90
8098	.90

OPTOCOUPLERS

MCT2	1.00
MCT6	3.30
MC275	1.50
MCC671	3.00
4N28	1.00
4N33	1.20
4N26	1.00

VOLTAGE REGULATORS

78L05	.40
LM341P-5	.80
7805	1.00
7905	1.70
LM309K	1.20
7805K	2.10
LM323-K	6.90
78H05KC	8.50
LM341p-8	.80
78L12CP	.40
79L12	.65
LM341P12	.75
7812	1.00
7912	1.90
7812KC	2.15
7912KC	2.60
79H12KC	8.00
78L15	.35
79L15	.65
LM341P15	.80
7815	1.00
7915CT	1.80
7915KC	2.60
78H15KC	6.50
78L18	.35
7818	1.40
78L24	.35
79L24	.65
7824	1.10
LM371T	2.40
LM337T	3.80
LM317K	4.50
LM337K	5.90
LM350K	8.40
78HGKC	10.50
78P05	16.50

BRIDGES

VM48	1.50
W02	.60
W04	.60
KHPC02	2.00
KBP602	2.50
KBP604	2.60
KBP606	2.80
KHPC1002	2.60
KBPC1004	3.20
KBPC1006	3.20
MDA3501	3.20
MDA3502	3.20
MDA3504	3.40

DISPLAYS

MAN2A	6.30
MAN72A	2.20
MAN74A	2.20
MAN52A	3.40
MAN82A	3.40
MAN84A	3.40
MAN6740	3.60
MAN8610	3.30
MAN8640	3.30
TIL306	12.00
DL704	2.20
DL707	2.30
DL747	3.40
DL750	4.00
FND357	1.80
FND500	1.80
FND507	1.80

DIP SWITCHES SPST

P/N	No. Switches	Price
SD3	3	1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

WIRE WRAP 3-LEVEL

	1-9	10-25
8 Pin	.75	.65
14 Pin	.90	.85
16 Pin	1.00	.90
18 Pin	1.20	1.10
20 Pin	1.40	1.30
22 Pin	1.60	1.40
24 Pin	1.90	1.80
28 Pin	2.20	2.10
36 Pin	2.60	2.40
40 Pin	2.90	2.70

COMPUTER GRADE ELECTRO.

2900uf	40V	6.50
6800uf	16V	6.40
10,000uf	16V	9.00
10,000uf	25V	9.50
10,000uf	40V	11.90
15,000uf	40V	12.00
22,000uf	25V	12.90
22,000uf	40V	23.00
27,000uf	35V	23.50
33,000uf	16V	23.50
68,000uf	16V	21.50
100,000uf	10V	20.50

MULTISTRAND RIBBON CABLE
Price per metre

	1-9	10+
10 Way	.80	.75
12 Way	1.00	.95
16 Way	1.20	1.10
20 Way	1.60	1.50
40 Way	3.20	3.00

IMARK for Japanese ICs and Transistors

TRANSISTORS

	$ c
2SA	
101	1.15
235	2.10
240	1.90
473	2.00
489	4.30
493	1.35
495	.75
495G, Y	1.10
496Y	1.60
505	1.65
509	1.40
539	1.20
561	1.80
562	.85
564A	1.40
608	1.50
628A	.65
634	1.95
636	4.50
639	1.15
640	1.15
641	1.15
642	1.30
661	1.35
670	2.45
671	2.55
673	.70
678	1.75
682 0	2.40
683	1.15
684	1.35
697	2.10
706	4.20
715	1.90
719Q	.90
720	1.15
726	1.55
733P Q	.70
740	7.60
748	3.00
758	8.65
769	3.90
794	2.45
816	1.90
844C	.75
844D	.75
885	2.15
950	3.00
969	6.30
999	.65
1015Y	.85
2SB	
56	.80
77	.95
156	1.90
187	1.00
324	.95
337	4.50
364	1.50
405	1.35
407	4.20
415	1.10
434	3.65
440	2.10
449	4.80
463	3.60
471	4.80
474	3.15
492	2.40
504	16.60
506	21.60

TRANSISTORS

	$ c
2SB	
509	6.30
511	2.20
512	4.60
514	2.55
525C	1.45
529	1.70
534	2.20
536A	3.25
536B	3.85
541	9.60
544	1.10
549	3.35
554	16.80
555	15.00
557	12.95
562	1.80
596	3.65
617	6.00
618A	9.00
647A	2.00
688	6.00
764	1.20
2SC	
281	1.90
371	.75
372Y	.70
373	.60
374	.75
380	.65
381Y	.90
382	1.70
383	1.50
385A	1.45
387A	1.45
388A	1.15
398Y	2.30
399	2.15
403C	1.30
454L	.50
458B, C	.60
460	.55
461	.95
485	5.50
494	9.30
495Y	1.60
496	3.70
498	3.60
509Y	1.75
535A	.70
536D	.50
538A	1.50
562	1.95
563	1.95
605	2.35
620C, D	.65
641	1.30
643A	8.65
644	.70
681	7.90
685	3.00
693	.55
710C	.80
710D	.80
711A, E	.55
712C	.70
717	2.00
728	2.75
730	9.90
731	15.35
732	.65
733	.65

TRANSISTORS

	$ c
2SC	
734	.90
735Y, O	1.00
738	.75
756	7.30
761	1.90
762	1.90
763D	.80
776	9.40
780	1.95
781	6.50
782	11.20
783	6.75
784R	2.50
785	.85
789	3.85
790	2.95
791	7.00
792	6.75
793	6.30
799	6.25
815	.90
828A	.90
828O, P	.90
829B, C	.75
838H	.85
839F, H	.60
871E	.80
900E	.70
900F	.70
900U	.70
901A	7.80
926	1.35
929	.65
930	.65
933	1.40
935	8.45
940L	6.40
941	1.20
943	2.30
945A,Q,R,S	.70
983	2.65
1000GR	1.10
1014C-2	1.65
1014D	1.65
1017	1.75
1018	3.80
1024	3.65
1047	.75
1060	1.70
1061A,B,C	1.60
1061D	1.60
1070	2.95
1096	1.40
1098	1.95
1106	9.40
1124	2.90
1162	1.15
1172B	18.60
1173	1.70
1175	.85
1210	.70
1213	.80
1214	1.90
1215	.70
1222	.70
1226A	1.25
1239	9.70
1260	6.40
1306	6.65
1307	7.85
1317	.75
1318R	.90

TRANSISTORS

	$ c
2SC	
1327T	.70
1328	1.20
1335	1.15
1344	.75
1346	1.50
1359	.90
1360	1.05
1362	1.70
1363	1.15
1364	.90
1368	1.75
1383R	1.30
1384Q,R	1.45
1393	1.60
1398	1.90
1419	2.45
1446	2.00
1447	3.95
1448	3.70
1449	2.75
1450	5.50
1475	1.90
1506K,L,M	1.55
1507K,L,M	1.55
1509	2.60
1550	1.95
1567	2.35
1568	2.35
1569	4.00
1571	.65
1583	2.10
1589	5.30
1591	39.70
1620	19.80
1647	.70
1674	.70
1675L	.70
1678	3.75
1683	3.10
1685	.75
1687	.95
1688	1.15
1740	2.90
1760	3.20
1775E	1.15
1810	5.85
1815GR	1.00
1815Y	1.00
1816	5.40
1827	3.90
1845	1.50
1846R	1.40
1848	1.95
1856	1.20
1906	1.75
1908	.95
1909	7.50
1923R	.85
1942	12.90
1945	14.00
1947	15.85
1957	1.35
1964	3.55
1967	26.60
1968A	39.65
1969C, H	6.90
1973	1.85
2053	3.15
2055	3.15
2073	2.85
2074	2.00
2075	4.95

TRANSISTORS

	$ c
2SC	
2076	.70
2086	1.05
2098	10.00
2099	26.90
2116	4.45
2131	9.20
2132	68.25
2146	4.55
2152	35.60
2166	3.65
2229	1.65
2233	4.35
2274	.85
2320	.65
2327	9.80
2724	.70
2SD	
30	1.30
91	8.10
93	8.40
111Y	10.50
113Y	26.10
180	5.95
187R	1.35
200	6.30
213	20.50
227	2.50
234	1.90
235Y	2.25
288	2.00
300	13.90
313E	1.80
315	3.40
318	4.00
325	1.60
330	1.75
350A	9.80
355C	1.05
359	1.80
380	9.70
388	6.30
389	3.60
400	.75
415	2.70
424	18.90
426	15.60
467	1.85
471	1.10
525	2.90
526	3.90
586	4.85
587S8	3.65
588A	8.25
667A	2.00
863	1.15
2SK	
19GR	1.45
19Y	1.45
30Y, A	1.30
33F	1.40
34E	1.25
40C	1.35
41D	1.05
41F	1.80
42	3.85
44	1.95
49H	1.85
548	1.05
55D	1.05
55E	1.05

TRANSISTORS

	$ c
2SK	
68 L	1.00
107	1.60
120	1.45
125	3.75
128	1.60
150	3.70
3SK	
37	5.85
39Q,R	4.10
40M	5.50
41L	4.95
45B	2.35
48	4.95
51-03	3.20
54B	3.05
59GR	2.90

INTEGRATED CIRCUITS

	$ c
AN	
214	5.25
217	4.10
240	14.70
272	8.10
315	7.95
360E	1.95
612	5.10
6552	2.95
7140	5.75
7151	6.95
BA	
501	9.25
511	9.25
521	9.25
CA	
3012	8.20
DS	
8654N	8.40
FX	
107	33.60
HA	
1156W	4.05
1199	4.55
1306W	5.40
1322	6.20
1329	4.75
1338	11.20
1339A	7.40
1342	5.45
1366W	7.50
1366WR	7.00
1367	11.40
1397	14.70
LA	
1201	2.90
4102	4.25
4420	4.10
4430	3.80
LM	
386N-1	1.30
M	
5115PR	12.90
5152L	5.15
51202L	3.10
51513L	14.40
58476	29.95

INTEGRATED CIRCUITS

	$ c
MB	
3705	4.80
3756	6.10
MC	
14001	1.85
14001BCP	1.60
14011	.65
14015	2.60
14016B	2.90
14028	1.90
14049	1.35
14066	1.65
14071	.85
14076	2.55
14511	3.10
14526B	6.95
14532	3.35
14543	4.30
14568B	12.55
1458	2.90
1496G	2.95
3340	5.65
4044	5.95
4069	1.35
MHW	
710-003	52.00
MM	
5369AA/N	5.95
5387AA/N	9.80
5799NBR	39.95
74C93	6.15
MSM	
100RS-8642	4.35
105R-7261	4.35
131R	6.60
153R	14.95
160R-7260	13.15
561	6.40
564	6.40
5107	11.75
5535	6.40
NDC	
40013	15.95
40044	24.80
NIS	
7261A	9.30
NJM	
4558D	2.85
PLL	
02A	15.85
RC	
4558	2.30
SL	
1626	11.50
1640	8.80
SN	
74161	1.95
74184	9.95
76115	3.65
76600P	5.55
TA	
78	6.55
7045	5.75
7055P	5.85
7060P	2.20
7061P	2.75

INTEGRATED CIRCUITS

	$ c
TA	
7062P	4.70
7063P	2.10
7069P	4.45
7073P	10.25
7089M	7.30
7102P	11.55
7108P	3.85
7120P	1.80
7130P	4.60
7141AP	12.00
7146P	12.00
7203P	9.50
7204P	4.85
7205P	4.55
7215P	12.00
7222AP	6.25
7227P	24.30
7310/C3001AN	4.40
7310/C3001AT	3.35
7310P	2.95
7313P	3.65
TBA	
810 SH	5.00
TC	
4508	11.75
5032P	16.25
5080P	11.80
5081P	8.45
5082P	8.45
9100	13.95

INTEGRATED CIRCUITS

	$ c
TMS	
1943 NL	16.00
uA	
703	3.65
UHIC	
005	9.95
uPC	
78L05	1.75
78L06	1.75
78L062AWC	2.70
78L62WV	2.70
78L08AC	1.75
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41C	5.40
555H	1.60
562C	9.45
566H	1.25
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576H	7.30
577H	1.60
587C2	6.95
592H2	1.55
1001H2	5.20
1020H	11.50
1025H	6.60
1156H	4.85
1181H	7.85
1182H	7.85
1350H	6.00
uPD	
858C	10.95

INTEGRATED CIRCUITS

	$ c
UP	
477-C12	69.00
Curtis	
8044	24.95

CRYSTALS

1.0000 MHz.	11.95
3.579545	7.50
7.4015	6.80
7.8015	9.90
9.555	4.80
9.565	4.80
10.000	6.95
10.020	4.50
10.0525	6.35
10.240	6.95
10.245	11.50
10.692	6.95
10.695	6.95
12.800	11.50
16.965	6.20
17.065	6.20
17.115	6.20
17.165	6.20
17.215	6.20
21.145	11.50
32.520	11.50
33.020	11.50
33.520	11.50
35.395	11.50
35.500	11.50
35.552083	11.50

CRYSTALS

	$ c
35.895 MHz.	11.50
35.96875	11.50
36.380	11.50
36.395	11.50
37.36875	11.50
37.76875	11.50
39.16875	11.50
40.4875	11.50
40.9875	11.50
41.000	11.50
41.4875	11.95
41.500	11.50
41.9875	11.50
42.000	11.50
42.500	11.50
43.500	11.50
44.000	11.50
50.77666	8.30
50.79666	8.30
50.80666	8.30
50.81666	8.30
50.82666	8.30
50.84666	8.30
50.85666	8.30
50.86666	8.30
50.87666	8.30
52.486666	10.20
52.4966	10.20
52.506666	10.20
52.5166	10.20
52.526666	10.20
52.5366	10.20
52.546666	10.20
52.5566	10.20
52.5666	10.20

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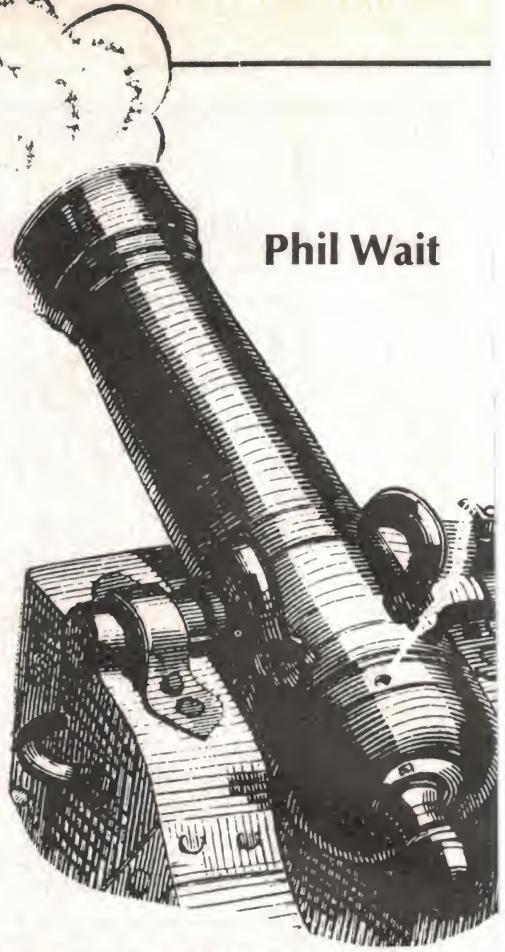
ETI981

Simple sound effects

Phil Wait



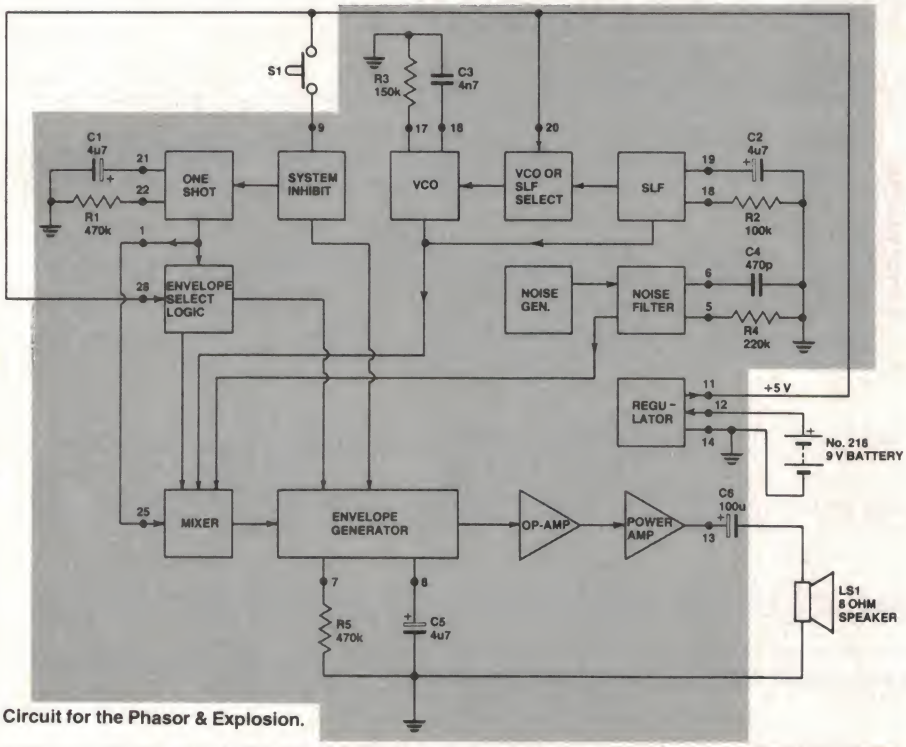
THIS MONTH we complete the series of Sound Effects projects with the description of how to construct the Phasor & Explosion unit (ETI-607D) and the Gunshot (ETI-607E).

ETI-607D

This combines the 'phasor' effect employed in the Alarm unit and the explosion effect employed in the Bomb Drop & Explosion unit. One could liken the sound produced to what you would expect after shooting down a 'flying saucer' or somesuch! This project uses about as many components as the Bomb Drop & Explosion board.

The SLF sweeps the VCO up and down in pitch at quite a rapid rate — somewhat faster than we did in the Alarm unit. The pushbutton is held down to start the effect, which takes several seconds to complete. The explosion is heard following a period of the phasor sound. As with the other units, if you wish to vary any of the parameters of the effect, it is best to vary the resistor values.

Take care with the orientation of the electrolytic and tantalum capacitors during construction. Note that, as with the ETI-607A Bomb Drop & Explosion unit, there are two links on the board; make sure you don't miss the small link at the 'notch' end of the IC.



Circuit for the Phasor & Explosion.

PARTS LIST — ETI 607D

Resistors ..... all ½W, 5%
- R1, R5 ..... 470k
- R2 ..... 100k
- R3 ..... 150k
- R4 ..... 220k

Capacitors
- C1, C2, C5 ..... 4u7/16 V electro.
- C3 ..... 4n7 greencap
- C4 ..... 470p ceramic
- C6 ..... 100u/16 V electro.

Semiconductors
- IC1 ..... SN76488

Miscellaneous
- S1 ..... SPST push-to-make pushbutton switch

ETI-607 pc board; 50 mm diameter 8 ohm speaker; No. 216 9 V battery and clip.

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$16 - $18

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

HOW IT WORKS

ETI 607D PHASOR & EXPLOSION

This unit is closely related to the ETI-607A Bomb Drop & Explosion. In fact, if you compare the two circuits you will find very little difference! In this unit the SLF is programmed to oscillate at several Hertz and the triangle wave output employed to control the VCO frequency. Thus the VCO is swept up and down in frequency several times per second. This creates the Phasor sound as in the ETI-607C Alarm unit. The explosion is triggered after the phasor sound runs for a few seconds, the whole sequence being controlled by the System Inhibit block in much the same way as done in the Bomb Drop & Explosion unit.

When S1 is pressed, a high (+5 V) is applied to the input of the System Inhibit block, pin 9. This triggers the One Shot and the Envelope Generator. The One Shot triggers the SLF Hi/LO Sync. (see SN76488 block diagram) at the start of the One Shot timing period, starting the SLF oscillating. This sweeps the VCO up and down as explained above and the signal passes to the speaker through the Mixer, Envelope Generator (which is inoperative at this time) and amplifier stages. When the One Shot completes its timing period the Envelope Select Logic becomes operative, the SLF is disabled and the Envelope Generator commences to do its thing. The Mixer now selects the Noise Generator/Filter output and the sound is heard to decay away, simulating an explosion.

The oscillation frequency of the SLF is determined by R2 and C2, while that of the VCO is determined by R3 and C3. The One Shot timing period is determined by R1 and C1, while the noise characteristic is determined by R4 and C4 on the Noise Filter programming pins (pins 5 and 6).

Audio output is coupled to the speaker via the obligatory 100 uF electrolytic capacitor, C6.

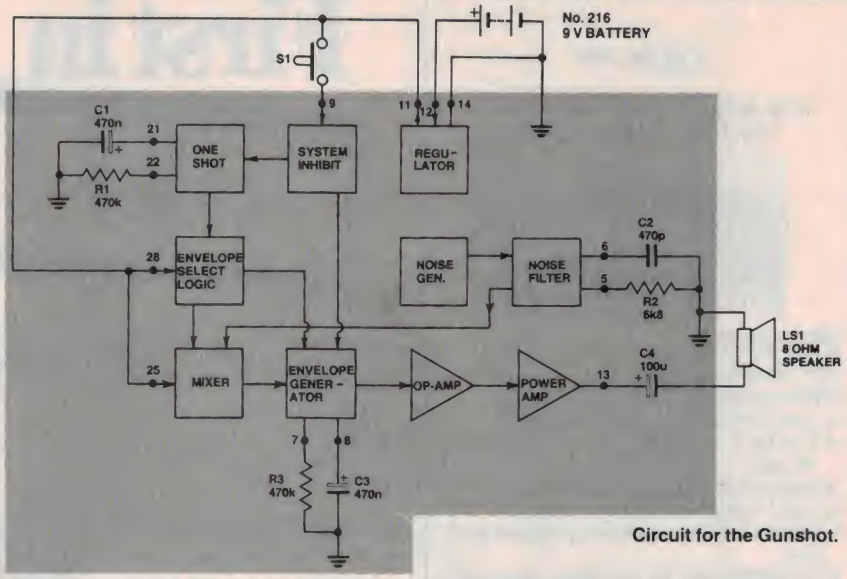
ETI-607E

This unit is quite straightforward. The Noise Generator blocks in the IC are employed to produce a suitable sound, which is heard for about a fifth of a second, dying away rapidly. The effect is triggered (pardon the pun) by the push-button. Only half a dozen components are required apart from the IC! With care, patience and a little juggling, the unit could be fitted inside a toy plastic gun by simply soldering the components between the IC pins. You would have to obtain a tiny loudspeaker, headphone unit or rocking armature insert for a speaker — whatever will fit in the gun assembly.

Supply bypassing

A short word on this subject may prevent difficulties in some cases. In general, we found that the power supply rail doesn't really need bypassing. However, provision has been made on the pc board for the inclusion of a bypass capacitor. This is located near the battery positive lead input on the pc board, which connects to pin 12 of the IC. Have a look at the component overlay for the ETI-607A Bomb Drop & Explosion unit. Locate C6, a 10n greencap. This is the supply bypass. A capacitor having any value between 10n and 10u, and which will fit on the board, will do the job.

That's it! Have fun with your Sound Effects. We're sure that, with a little ingenuity and experimentation, you'll be able to devise a few effects of your own. (If you do, we'd like to hear from you and will pay for any items published). ●



Circuit for the Gunshot.

HOW IT WORKS — ETI 607E GUNSHOT — PARTS LIST

A gunshot is simulated by producing a burst of noise that decays very quickly. This unit employs the Noise Generator, Noise Filter, One Shot, Mixer and Envelope Generator to generate the required sound.

The Mixer select pin (25) and the Envelope select pin (28) are both held high (+5 V), selecting the One Shot output function from the Mixer. When the pushbutton, S1, is pressed this puts a high on pin 9 and the System inhibit block triggers the One Shot and activates the Envelope Generator. For the duration of the One Shot period, the modified noise from the Noise Generator/Filter is passed through the Mixer and Envelope Generator and then to the audio output stages.

The One Shot period, determined by R1 and C1, is quite short (about 1/5 second) and the decay period of the Envelope Generator a little longer. Audio output is coupled to the speaker via the 100μ dc blocking capacitor, C4.

Resistors ..... all ½W, 5%
R1, R3 ..... 470k
R2 ..... 6k8

Capacitors
C1, C3 ..... 470n tant. or RBLL
C2 ..... 470p ceramic
C4 ..... 100u/16 V electro.

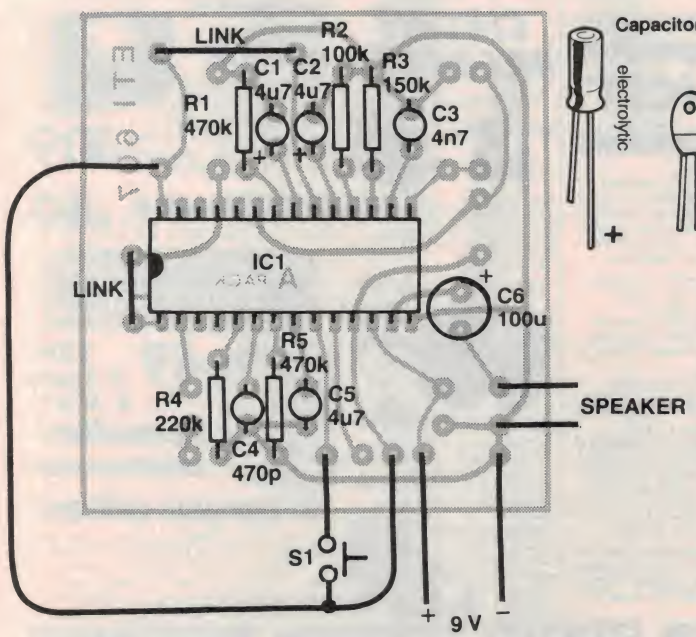
Semiconductors
IC1 ..... SN76488

Miscellaneous
S1 ..... SPST push-to-make pushbutton switch
ETI-607 pc board; 50 mm diameter 8 ohm speaker; No. 216 9 V battery and clip.

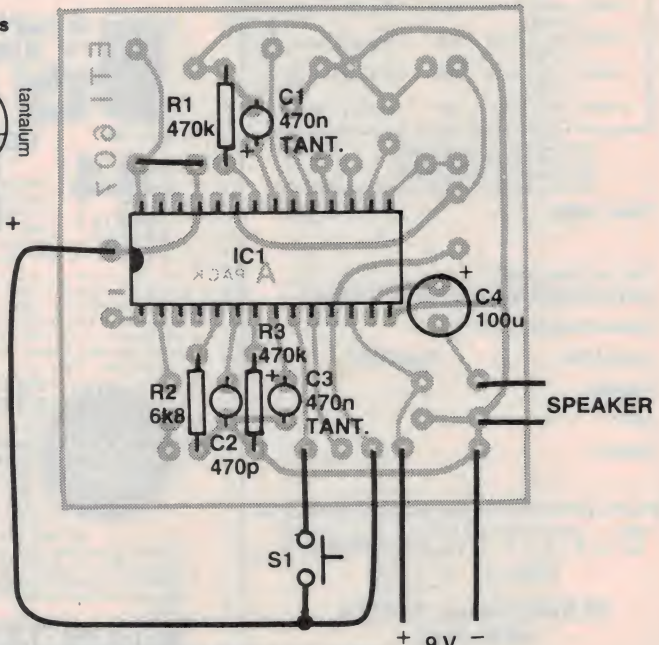
Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$14 - $17



Overlay for the Phasor & Explosion.



Overlay for the Gunshot. Don't forget the link.

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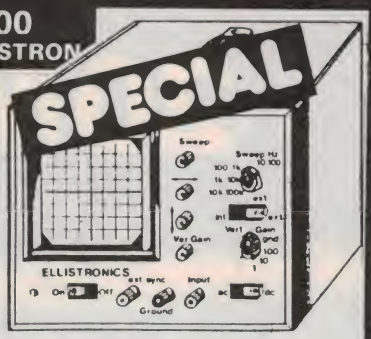
Horizontal deflection sensitivity: 500mV per division
Time base sweep frequency: 10Hz to 100kHz in 4 ranges
Synchronisation: internal and external.



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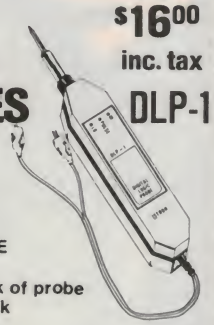

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Input Impedance 300k

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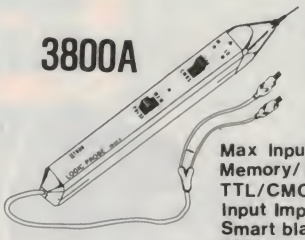

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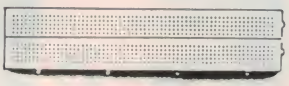

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TWEETERS										
AD 0182-T8	25 mm	8 Ohm	20 - 80	2000-22000Hz	1000Hz	0.24kg	(1W/1M) 93dB	*$10.28	$8.21	A
Ad 0182-T15	25mm	15 Ohm	20-80	2000-22000Hz	1000Hz	0.24kg	(1W/1M) 90dB	*$10.28	$8.21	A
AD 0140-T8	25mm	8 Ohm	20-50	1800-20000Hz	1200Hz	1kg	(1W/1M) 90dB	*$9.33	$7.47	A
AD 01810-T8	25mm	8 Ohm	20-100	750-22000Hz	1250Hz	0.24kg	(1W/1M) 90dB	*$12.40	$9.92	A
AD 2273-T8	50mm	8 Ohm	10	1500-10000Hz	1000Hz	0.02kg	(1W/1M) 88dB	*$4.00	$3.20	A
SQUAWKERS										
AD 0210SQ8	50mm	8 Ohm	40-60	550-5000Hz	350Hz	0.42kg	(1W/1M) 89dB	*$25.88	$20.89	A
AD 5060SQ8	125mm	8 Ohm	40-60	400-5000Hz	210Hz	0.23kg	(1W/1M) 90dB	*$17.39	$13.92	A
AD 02161SQ8	50mm	8 Ohm	40-100	500-10000Hz	320Hz	0.85kg	(1W/1M) 89dB	*$26.39	$21.12	A
WOOFERS										
AD 12100W8	300mm	8 Ohm	40	40-1200Hz	19Hz	1.15kg	(1W/1M) 90dB	*$42.58	$34.06	A
AD 12250W8	300mm	8 Ohm	100	40-3500Hz	24Hz	1.15kg	(1W/1M) 91dB	*$70.77	$58.82	A
AD 12850W8	300mm	8 Ohm	60	30-2000Hz	23Hz	0.53kg	(1W/1M) 90dB	*$57.64	$48.12	A
AD 10100W8	255mm	8 Ohm	40	80-1500Hz	25Hz	1.05kg	(1W/1M) 90dB	*$41.25	$33.00	A
AD 8061W8	200mm	8 Ohm	30	40-8000Hz	42Hz	0.28kg	(1W/1M) 90dB	*$15.93	$12.75	A
AD 80852W8	200mm	8 Ohm	50	50-5000Hz	39Hz	0.45kg	(1W/1M) 90dB	*$20.88	$18.53	A
AD 70601W8	180mm	8 Ohm	30	40-3000Hz	45Hz	0.28kg	(1W/1M) 88dB	*$18.88	$14.93	A
AD 5060W8	125mm	8 Ohm	10	50-5000Hz	60Hz	0.23kg	(1W/1M) 87dB	*$13.88	$11.09	A
FULL RANGE										
AD 12100M8	300mm	8 Ohm	25	30-13000Hz	45Hz	1kg	(1W/1M) 99dB	*$82.38	$49.90	A
AD 9710M8	218mm	8 Ohm	20	45-19000Hz	50Hz	0.4kg	(1W/1M) 95dB	*$32.45	$25.96	A
AD 8081 M8	200mm	8 Ohm	8	50-14000Hz	75Hz	0.1kg	(1W/1M) 90dB	*$7.73	$8.19	A
AD 7062M8	180mm	8 Ohm	30	50-13000Hz	45Hz	0.28kg	(1W/1M) 89dB	*$17.00	$13.60	A
AD 5061-M	125mm	8 Ohm	15	75-20000Hz	85Hz	0.28kg	(1W/1M) 91dB	*$13.53	$10.83	A

CROSSOVERS	TYPE	CROSSOVER FREQUENCIES	ROLL-OFF	IMPEDANCE	POWER INPUT	*TRADE PRICE + SALES TAX	DEALER COST + SALES TAX	
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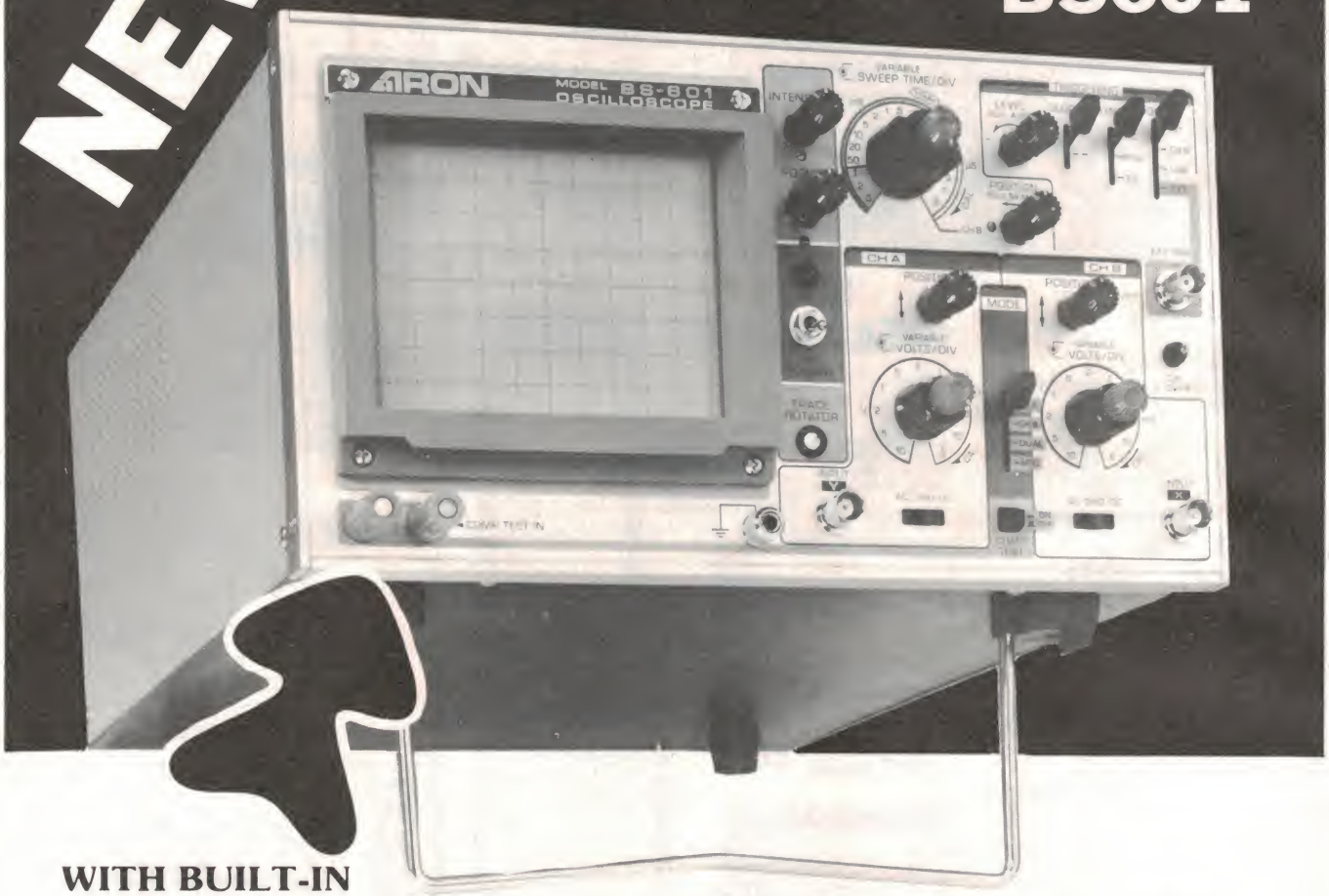

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BC159 (BC179,BC214,BC559)	Z-1359	17c
BC639 BC640	Z-1388	45c
BC640	Z-1389	45c
BCY71	Z-1241	95c
BD139	Z-1443	55c
BD140	Z-1444	55c
BD682	Z-1460	$1.45
BD681	Z-1462	$1.26
BF115	Z-1560	75c
BF173	Z-1590	89c
BF180	Z-1602	73c
BF184	Z-1604	$1.00
CL33 NPN disp driver	Z-1750	$1.00
CL34 PNP disp driver	Z-1752	90c
D13T1 (2N6027) PUT	Z-1780	59c
DS2646 UJT	Z-1786	95c
FPT100 (photo trans)	Z-1950	$1.38
MEL12 (photo darlington)	Z-1952	95c
MJ2955	Z-1800	$1.50
MPF102	Z-1832	59c
MPF105 (2N5459)	Z-1838	58c
MPF106 (2N5484)	Z-1840	58c
MPF131 (MPF121)	Z-1848	$1.20
OC26 (AD149)	Z-1930	$2.75
OC44	Z-1932	95c
OC71	Z-1941	75c
TIP31B	Z-2020	79c
TIP32B	Z-2024	79c
TIP2955 (MJE2955)	Z-2005	$1.25
TIP3055(MJE3055)	Z-2008	$1.25
TT800(2N4030)	Z-2064	89c
TT801(2N3019)	Z-2068	89c
2N2053	Z-2130	53c
2N3055	Z-2145	83c
2N3055 (Motorola)	Z-1804	$1.50
PN3563	Z-2180	30c
BC337	Z-2190	23c
BC328	Z-2242	17c
2N4360	Z-2246	22c
PN3642	Z-2250	45c
BC338	Z-2252	30c
PN3645	Z-2256	25c
PN4250	Z-2320	48c
PN4258	Z-2326	38c
2N4342	Z-1833	$1.18
2N5484	Z-2340	58c
2N5590	Z-2390	$6.50
2N5591	Z-2391	$12.95
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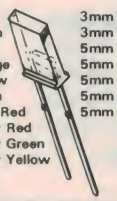

Type No	Size	Cat No	Price
Small Red	3mm	Z-4010	20c
Small Green	3mm	Z-4020	28c
Large Red	5mm	Z-4030	16c
Large Orange	5mm	Z-4036	55c
Large Yellow	5mm	Z-4034	34c
Large Green	5mm	Z-4032	28c
Large clear Red	5mm	Z-4038	55c
Rectangular Red		Z-4040	40c
Rectangular Green		Z-4042	40c
Rectangular Yellow		Z-4044	40c
Infra Red		Z-3235	$1.50

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Type No	PIV	A	Cat No	Price
1N4002 (EM401)	100	1	Z-3202	6c
1N4004	400	1	Z-3204	8c
1N4007 (EM410)	1000	1	Z-3207	14c
1N5408 (MR510)	1000	3	Z-3228	43c
1N5404 (1N5624)	400	3	Z-3222	43c
MR110 (S0-10 stud)	100	10	Z-3240	$1.45
MR410 (S0-10 stud)	400	10	Z-3244	$1.95
BYX21L/200	200	25	Z-3260	$1.95
BYX21L/200R	200 (r)	25	Z-3262	$1.90
WO-2 bridge	200	1.5	Z-3300	$1.90
WO-4 bridge	400	1.5	Z-3304	70c
PA60 bridge	600	8	Z-3326	$5.50
PB40 bridge	400	25	Z-3334	$5.50

SIGNAL DIODES

Type No	Type	Cat No	Price
DSOA91	Germ G/P	Z-3042	12c
OA47	Gold Bonded	Z-3232	38c
OA90	Germ G/P	Z-3030	18c
OA91	Germ G/P	Z-3040	18c
OA95	Germ G/P	Z-3050	18c
BB119	Silicon G/P	Z-3060	34c
BA102	Sil Varicap	Z-3070	43c
OA202	Sil small signal	Z-3100	34c
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2N5245	N Channel JFET	Z-2335	90c
–	4 digit L/C display	Z-4175	$8.95
MC3021	Opto Triac Driver	Z-4516	$2.75
-	60 deg. solar cell	Z-4835	$2.95
74LS05	Hex Inverter	Z-4905	40c
74LS32	Quad 2 input NOR	Z-4932	35c
74LS86	Quad 2input OR	Z-4986	45c
74109	Dual J/K flip flop	Z-5252	50c
74157	Multiplexer	Z-5267	85c
74LS139	Multiplexer	Z-5285	90c
74LS165	Par load 8 bit s/r	Z-5288	$1.65
74LS1746	bit D flip-flop	Z-5290	$1.00
74LS367	Hex driver/3 st o/p	Z-5292	75c
74LS373	Dual D flip flop	Z-5295	$1.95
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8V2 (1N4738)	Z-3535	9V1 (1N4739)	Z-3537
10V (1N4740)	Z-3539	11V (1N4741)	Z-3541
12V (1N4742)	Z-3543	13V (1N4743)	Z-3545
15V (1N4744)	Z-3547	16V (1N4745)	Z-3549
18V (1N4746)	Z-3551	20V (1N4747)	Z-3553
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Lab Notes

The tender touch

If you ever get involved in the design of electronic equipment, there is a fair chance that you will eventually come across a circuit that requires the use of a 'press-to-do-something' switch. You'll then have to decide whether to use an electromechanical pushbutton switch or a solid-state 'touch' switch to do the job.

Ray Marston

THE MAIN disadvantages of the pushbutton switch are that it is unreliable, tends to be a bit expensive and is available only in those designs that manufacturers care to produce. These switches are also 'noisy' in that they generate contact-bounce spikes that can play havoc with fast digital circuitry.

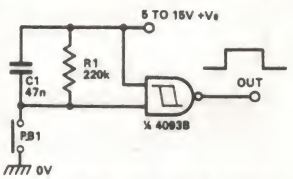

Figure 1. **Push-button debouncer circuit.**

This last-mentioned problem can be overcome by using the 'debouncer' circuit of Figure 1. Here, one quarter of a 4093B CMOS quad 2-input NAND Schmitt is used as a simple Schmitt trigger. When PB1 is closed, C1 charges rapidly to full supply volts and the Schmitt output switches high; when PB1 is released C1 discharges slowly via R1 until eventually the Schmitt output switches low again. The circuit is thus unaffected by switch contact bounce and produces a clean on/off signal at the Schmitt output.

Figure 2 shows a useful way of obtaining a toggle (alternate on-off) action from a simple pushbutton switch. The switch signal is debounced by R1-C1 and is then used to clock one half of the 4027B dual JK flip-flop, which divides the clock signal by two. Thus, the 4027B output goes high on one press, low on the next, high on the next and so on. Two of these toggle switches can be built from each 4027B IC in the dual package.

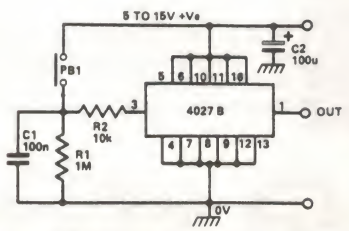

Figure 2. **Push-button toggle switch.**

Touch switch circuits

The main advantages of solid-state switches are that they are reliable (they have no troublesome mechanical parts), can be less expensive than their electromechanical counterparts and can readily be produced in almost any shape or form that the designer or home constructor wishes.

Touch switch circuits come in three basic types (ignoring 'freak' circuits such as thermo-switches, etc). The crudest and least attractive of these are the 'resistive' types, which use the 'touched' or 'untouched' resistance change that occurs between two adjacent touch contacts to give activation.

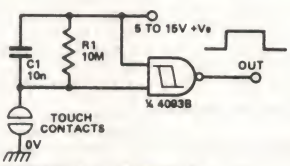

Figure 3. **Resistive touch switch.**

Figure 3 shows a typical resistive touch switch circuit. Normally with the contacts untouched, R1 holds the Schmitt input high and its output is low. When a finger is used to bridge the two contacts the resulting skin resistance (less than 3M) pulls the Schmitt input low and drives its output high. C1 is used to 'debounce' the circuit. Figure 4 shows how the circuit can be modified to give 'toggle' action.

A very serious disadvantage of the resistive touch switch is that it can be disabled by moisture or contamination bridging the contacts. Also, it may be disabled by persons with damp fingers or may be immune to operations by persons with very dry skins.

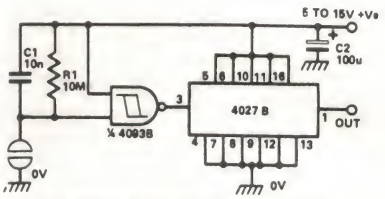

Figure 4. **Resistive touch toggle switch.**

A great improvement in reliability is given by a second type of 'hum-detecting' touch switch. This type of circuit relies for its operation the fact that the human body acts as a kind of antenna that is coupled to the mains and carries a high-impedance mains signal. Figure 5 shows an example of this type of circuit. When the input contact is touched the hum pick-up signal is fed to the input of the first Schmitt stage via limiting resistor R2 and produces a full-amplitude square wave at the Schmitt output. This square wave is converted to dc and debounced by the D1-R3-R4-C1 network, and drives the final output of the second Schmitt high. The Schmitt output goes low again some 60 mS after the input touch is removed. Figure 6 shows how the above circuit can be modified to give toggle operation; D2 and C2 prevent unwanted feedback from the 4027B to the Schmitt.

Capacitive touch proximity switches

The third and most important class of switch is those that work on the capacitive loading principle. In most simple cases, these circuits rely on the fact that the human body acts as a small

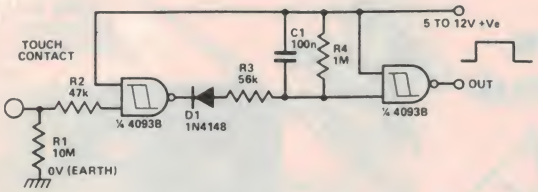

Figure 5. **Hum-detecting touch switch.**

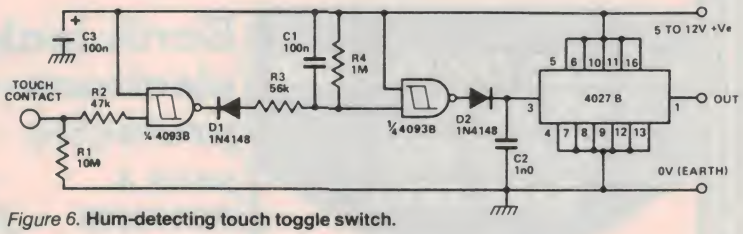

Figure 6. **Hum-detecting touch toggle switch.**

capacitor that is earthed at one end. The actual value of capacitance depends on physique and on environmental conditions, but is reckoned to have a value of 150-300p under normal domestic/industrial conditions.

Figure 7 shows a number of basic ways of using the body capacitance effect. In Figure 7a it causes loading of an HF oscillator, in Figure 7b it causes capacitive potential division and in Figure 7c it causes filtering of oscillator harmonics. Of particular interest is Figure 7d, which shows that these effects can be obtained without physical contact, by capacitive or 'proximity' coupling.

Figure 8 shows the practical circuit of a touch/proximity switch that works on the oscillator damping principle. The oscillator is a Colpitts, working at about 300 kHz. RV1 is carefully adjusted so that oscillation is barely sustained when the contact is untouched. Under this condition the rectified output of the oscillator drives Q3 to saturation and holds the circuit's output low. When the contact is touched the resulting capacitive loading kills the oscillator, causing Q3 to turn off and switch the output high. The output has relatively slow rise and fall times, but can be speeded up with a Schmitt circuit if required.

The zero volts line of the Figure 8 circuit should (ideally) be grounded. The touch contact must be made from a conductive material, but can be any shape or size that is desired; in most cases the 'contact' face can be covered with an insulating material without detracting from the circuit's performance. Pin-head sized contacts will require actual-contact operation, but 'contacts' with surface area of a square metre or so can be proximity-operated at ranges up to 20-40 centimetres.

Finally, Figure 9 shows the circuit of a touch switch that works on the capacitive-divider principle. Here, IC1 is wired as a ring-of-three oscillator working at a frequency of a few hundred kHz. The oscillator output is fed to a capacitive potential divider formed by C2 and the stray capacitance around D1 and the touch contact. The resulting potential divider output signal is rectified by D1-D2-C3-R2 and fed to the 3140 regenerative voltage comparator, which is adjusted (via RV1) so that its output is just switched to the low state when the input contact is untouched. When the contact is touched, the resulting capacitive loading increases the effective capacitance of the lower half of the potential divider, thereby reducing the divider's output voltage and causing the 3140 output to switch high. Figure 9b shows an add-on section that can be used to convert the circuit to toggle operation.

As in the case of the Figure 8 circuit, the zero volt line of Figure 9 should be grounded. The touch contacts can again be any desired shape or size. ●

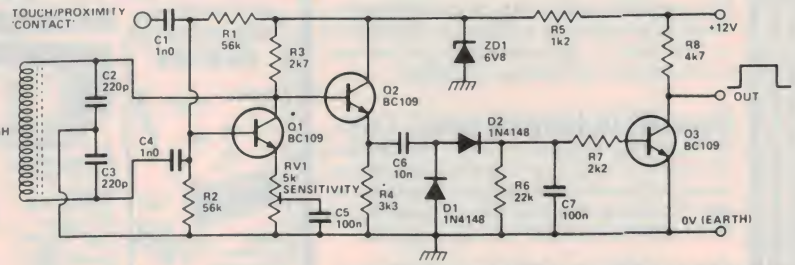

Figure 8. **Damped oscillator touch/proximity switch.**

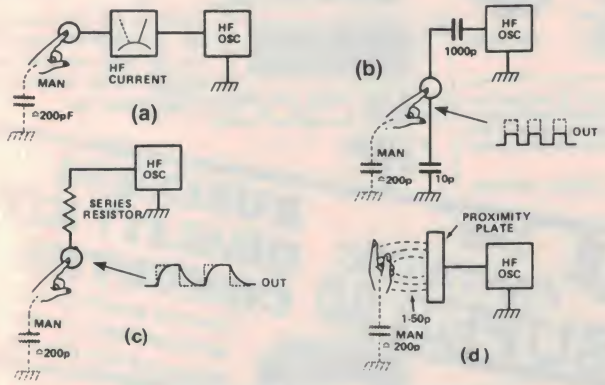

Figure 7. **Body capacitance effects on a touch contact. (a) Causes oscillator loading, (b) capacitive potential divider action or (c) degradation of oscillator waveform (harmonic filtering). (d) If contact is of sufficient area, loading and other effects can be obtained without physical contact, by capacitive or proximity coupling.**

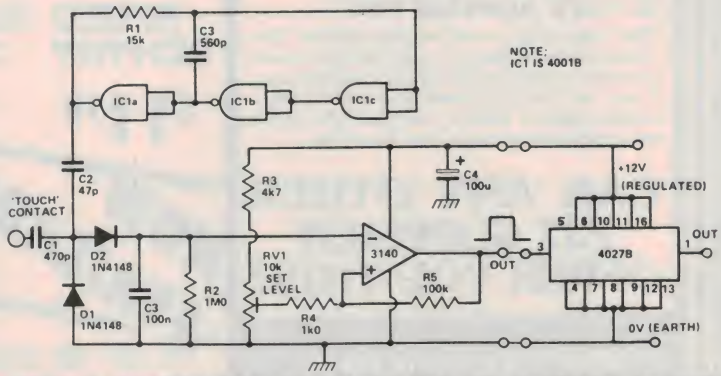

Figure 9. **Capacitive-divider touch switch (left) with modification for toggle operation (right).**

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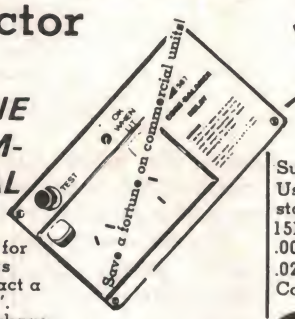

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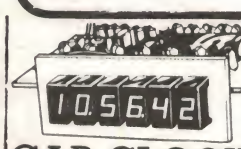

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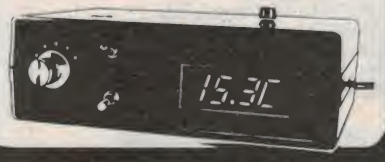

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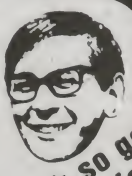

REMEMBER: They look so good your friends will never believe you built them!

Shoparound

ETI-478MM & MC stages

These two projects are the low level input stages of the Series 5000 Preamp and have been designed to deliver state of the art performance. As we've not compromised on the design we suggest you don't compromise on the components. The pc board is essential for each to preserve the layout and 'earthing', a very necessary requirement if the full performance is to be achieved.

The MM and MC amps have been designed using the relatively new, high performance NE5534N and NE5534AN op-amps. Accept no substitutes. For the MC stage a super-matched transistor pair, the LM394, is used to achieve low noise performance. Note that an inductor (L1) is used on the input of this stage. It consists of two turns wound on a ferrite balun core, 6 mm long by 13 mm wide. We used a Neosid type, variously known as No. 1050/2/F14 or 42-002-31. It's a common component. Suppliers were circulated tentative parts lists for these units some months ago so kits and/or components should be widely available. There was some difficulty with shortage of supply of the LM394 in July but this situation should be cleared up by the time this issue goes on sale.

These units may be used as stand-alone preamps and incorporated in an existing design if you wish, but pay attention to shielding and earthing.

Note that, when purchasing pc boards, they both have the same project number, ETI-478. The moving magnet stage is identified by the 'MM' suffix, the moving coil stage by the 'MC' suffix.

ETI-607 D, E sound effects

The Phasor & Explosion plus the Gunshot effects are presented this month to complete the series of five effects units that we commenced last month. By this stage, constructors should experience little difficulty in obtaining the SN76488 IC, the pc board and other components.

Kits are widely stocked by stores such as Dick Smith Electronics (all states & N.Z.), Altronics in Perth, All Electronic Components and Rod Irving in Melbourne and Electronic Agencies in Sydney. The SN76488 is stocked by the above suppliers as well as VSI's Silicon Valley stores, not to mention Tandy outlets. Prices vary from a low of $4.95 up to $9.95. It pays to shop around! Kit prices vary widely too, we noticed, and our price estimates in the project parts lists tend to be well on the high side. Which is good news for you.

Again, we should draw your attention to the fact that the SN76488 is available in two different packages, but having the same pinout. The larger is called the A pack, is 15 mm wide and has 2.54 mm pin spacing. The smaller is called the NF pack and is 10 mm wide with 1.52 mm pin spacing. As a consequence, we had to design two pc boards and each is marked 'A pack' and 'nf pack' to suit the different pack styles. Make sure you purchase the correct pc board to suit the IC pack you obtain. Printed circuit board artwork was reproduced on page 159 of the August issue with the page behind (160) in blue so that you can make your own negatives for pc board production at home.

Specials

In case you missed out, last month's issue included (or should have) a 'Monster' catalogue insert from Sheridan Electronics who skulk in their monster hideout at 164-166 Redfern St, Redfern NSW. If their 8-page tabloid Monster Sale catalogue was missing from your issue you can find out all about the latest goodies they have to offer by calling in or writing to them. Amongst the goodies hobbyists hanker after are custom-made steel and aluminium cases at unheard-of prices, Arlec high impact plastic instrument cases, low-price computer grade electrolytic capacitors, bargains in switches of all sorts and tools at terrific prices. We also spotted tantalums in popular values for under 20 cents a piece. And to keep them all you'll need capstan cabinets which they have for under $4 a four-drawer unit. It's *monstrous!*

Not content with giving away resistors (see last month's Shoparound), Jaycar have bought up the entire stock of the once well-known mail order company, Micronics, who traded from Randwick in Sydney. Gary Johnston, Jaycar's proprietor, says he'd like to share the cost-savings with customers so he's offering tens of thousands of low signal transistors for a song along with 5W audio ICs, AE suffix 4000 series CMOS devices (as low as 15 cents!) and what all. Call in to their showroom at 380 Sussex St, Sydney (spend your savings on a good Chinese feed in Dixon St afterwards) or send an SSAE.

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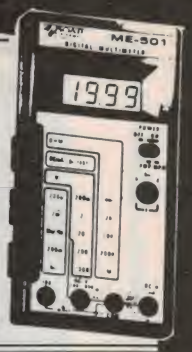

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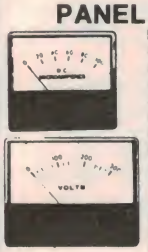
HS11 — 38mm	1.40	1.20	1.00	0.90	0.80	0.70
HS12 — 75mm	2.50	2.20	1.90	1.60	1.25	1.20
HS13 — 150mm	4.90	4.50	4.00	3.20	2.45	2.40

PANEL METERS



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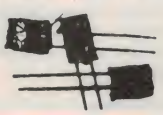

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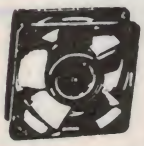

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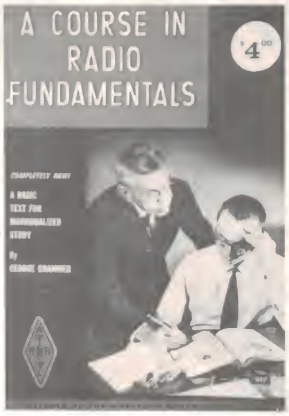

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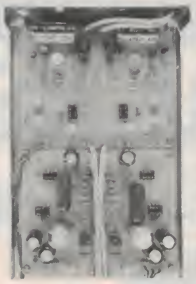
THIS MONTHS KITS



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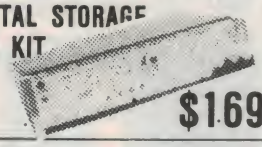

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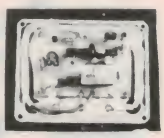

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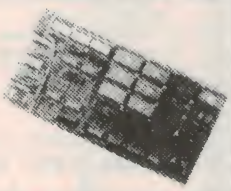

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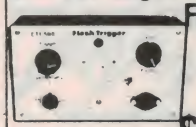

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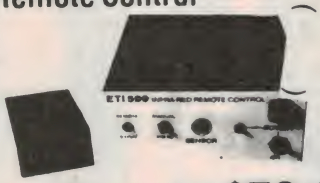

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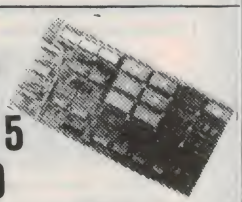

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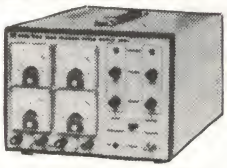

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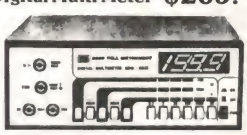

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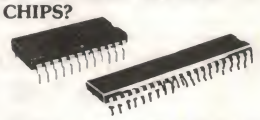

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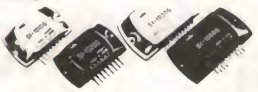

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PT8P47K	47 K OHM
PT8P100K	100 K OHM
PT8P220K	220 K OHM
PT8P470K	470 K OHM
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Hitachi Denshi, Ltd.

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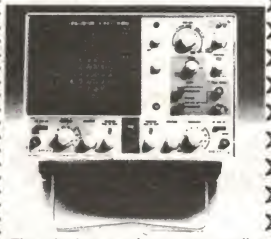

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SPECIAL $799 + s/tax

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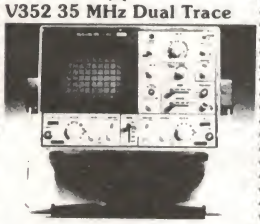
V352 35 MHz Dual Trace



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- Signal delay line
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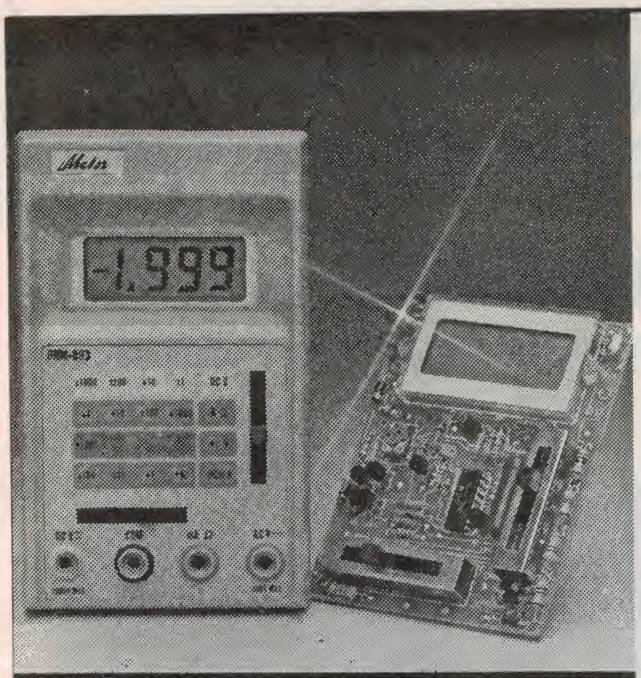

DIGITAL MULTIMETER DMM-803

KIT $79.85 inc. Tax

The **DMM803** Digital Multimeter is a compact, hand-held instrument designed for both field and laboratory use. Measurement functions includes DC voltage, AC voltage, DC current and Resistance. All functions are protected by diodes and transistors against overload. The large LCD readout features easy-to-read numerals, polarity indication and low-battery warning. The kit contains all the parts necessary for making a finished Digital Multimeter and a detailed assembly manual to ensure easy assembly.

Feature

1. Measurement function: DCV, ACV, OHM & DCmA.
2. 0.5" 3½ digit liquid crystal display.
3. Overload protection.
4. Polarity indication.
5. Battery life: Approx. 250 hours (Alkaline battery).
6. Single 9V battery operation with low battery warning "LO-BAT" indicator in the last 20% of battery life.
7. Size: 8.4(W) x 14(L) x 3(H) cm.

Measurement Ranges

Function	Accuracy	Range	Resolution	Overload
DC V	± (0.8% of rdg + 1 dgt)	2 V	1 mV	DC 1000 V AC 1000 Vrms
		20 V	10 mV	
		200 V	100 mV	
		2000 V	1 V	
AC V	± (1% of rdg + 0.3%F.S.+1 dgt)	500 V	1 V	AC 1000 Vrms
OHM	± (0.5% of rdg + 1 dgt)	2 KΩ	1Ω	DC 250 V AC 250 Vrms
		20 KΩ	10Ω	
		200 KΩ	100Ω	
		2 MΩ	1 KΩ	
DC mA	± (1% of rdg + 1 dgt)	200 µA	100 nA	1 A
		2 mA	1 µA	
		20 mA	10 µA	
		200 mA	100 µA	

Operating Temperature: 0° ~ 40°C
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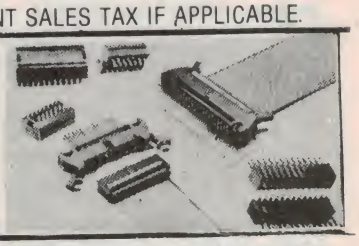

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COMMUNICATIONS

Satellite TV arrives!

Hills Industries installed the first commercial satellite TV reception system in Australia during May.

The first Hills 'Telesat' outback satellite receiving system has been installed at the Uluru Hotel at Ayers Rock in central Australia. By all reports, it's performing well, receiving pictures from the international communications satellite, Intelsat IV.

In launching the system at a Sydney press conference, the managing director of Hills Industries, Mr. Bob Ling, said that access to television would now be available to most Australians for the first time.

Hill's Telesat systems are expected to cost around $7000 to $7500, depending on location.

The Telesat system consists of a five-metre square screen reflector antenna (sector of a sphere) which reflects the primary signal to a 'collecting horn' antenna about seven metres away. A special low-noise amplifier feeds a down converter, which then connects via a long length of coax to a converter unit which demodulates the video and audio, and remodulates this onto an RF modulator which connects, in turn, to the antenna of a normal TV set.

The central "footprint" of Intelsat IV covers a vast area of Australia, extending over most of Western Australia, South Australia, Northern Territory, Western Queensland and also part of New South Wales.

Mr. Ling said, "ABC television programmes from both Sydney and Perth can be received, with a picture quality within the central footprint as good as the average suburban home. For the same price many people pay for caravans, boats or holidays, people in remote areas will be able to watch quality television for the first time, and will be able to get today's news today. This system will bring communication, entertainment and education to hundreds of thousands of Australians in remote areas."

Hills Industries Limited, who hold the exclusive Australian selling rights for the Telesat outback satellite receiving systems, will be selling and installing them Australia-wide.

Hills' Telesat system was designed by a leading American communications scientist, Professor Taylor Howard of Stanford University, exclusively for Perth-based Australian Microwave systems Pty. Ltd.

Professor Taylor Howard, a leading authority on space and satellite communications who received a NASA medal in 1973 for exceptional scientific achievement for contributions to the Apollo programm . said, "I have invented similar systems for the United States, but Australian conditions, including Intelsat IV frequencies and signal strengths, meant designing a unique system."

(The Editor would like to inform readers that, no, we are not considering designing and publishing a satellite receiving system for Intelsat IV in the near future.)

OSCAR 7 dying

A sudden failure reported on June 12 followed by weak Mode B operation in subsequent weeks seems to confirm that OSCAR 7, one of amateur radio's most successful space experiments, has irreversible battery failure.

One battery pack, reported to have been inoperative since a cell failed in 1978, seems to have gone short circuit, pulling the power buss down.

The failure has been attributed to thermal stresses induced by the solar eclipse the satellite has been experiencing each orbit since May 22.

One of the most successful satellites still flying, OSCAR 7 had a design life of three years and has lasted more than six and a half years! Its predecessor, OSCAR 6, had a design life of one year and lasted four and a half. Not bad for an 'amateur' satellite.

Meanwhile, AMSAT's Phase 3B satellite has finally been specifically approved in writing by the European Space Agency for the Arianne launch now scheduled for October 1982. There's a possibility this may move to June or April (less likely). Construction proceeds on schedule.

Info courtesy HR Report

China on 20m?

It seems from various reports that the People's Republic of China is to permit limited amateur operation from that country during September, following permission being tentatively granted to a group from the Echo DX Club from the US.

Australian amateurs have been rumoured to have gained permission too, but we've heard no further confirmation. Will BY be reactivated? (HR Report).

Booster for IC2A

Icom recently announced the release of a power booster, the IC-ML1, for the IC2A handheld.

The IC-ML1 is a ten watt power booster designed to facilitate mobile operation of the IC2A, and with its small size and light weight should fit comfortably into a small space in any car.

The dc voltage for transmit/receive switching is superimposed on the RF coaxial cable, which permits the amplifier to be controlled by a single coaxial cable connection. Unlike carrier-control methods there is no initial transmission cut-off, and the IC-ML1 also has APC circuit, which deactivates the booster when the collector current is above that specified in order to protect the final transistor.

A limited number of these power boosters is in stock at Vicom International Pty Ltd, 57 City Road, South Melbourne, (03)699-6700, or at their Sydney office at 339 Pacific Highway, Crows Nest NSW, (02) 436-2766.

Telecom blackout — amateurs called in

During the recent industrial dispute which crippled the normal telecommunications systems, it became impossible for the public to send urgent messages, except by mail. Amateur emergency services were called on to help.

People with messages involving serious illness, accidents, medical transport needs, funeral details and even advice of a death in the family had to ring the police to ask them to relay these messages.

As the communications problems had prevented any telephone or telex contact outside local areas, the NSW police found that the number of incoming messages was greater than they could handle while maintaining their normal responsibilities, which were extended due to the telecommunications outages.

At 09.20 on Sunday June 14 the NSW police decided to activate WICEN — the Wireless Institute Civil Emergency Network. The Wireless Institute of Australia has co-ordinated the amateur radio service since 1910, and formed WICEN as a group of amateurs specially trained in providing emergency communications in the 1930s, when the authorities had very limited communications. Today WICEN still assists whenever requested by the authorities.

During this emergency WICEN maintained radio links over the whole of Australia. Sixty-seven messages were referred by the police to WICEN, consisting of advices of death in the family, enquiries about a patient's condition, advices of serious illness, medical transport advices, police messages and funeral details.

Most of these messages were transmitted by radio and then telephoned at the distant end within five minutes of receipt. Where a reply was required this was usually phoned to the message originator within ten minutes of the original message being received.

At the same time, individual amateur operators handled a large quantity of lower priority messages for the public. This emergency gave the amateur radio service yet another opportunity to serve the community through its emergency communications group — WICEN.

(Many thanks to Mike Richter, NSW WICEN Deputy Co-ordinator, for a fine press release).

Melbourne — centre of the world?

GFS Electronic Imports now have reprints of their popular Melbourne-centred Great Circle map, which gives users the true direction and distance from Melbourne to every point on the earth's surface.

Such a Great Circle map — otherwise known as a zenithal azimuthal chart — enables the accurate directing of beam-type antennas. It may be used with slightly reduced accuracy from any city in Australia.

The map measures 430 x 320 mm, and costs $2 including postage.

GFS also have available the 1981 Foreign Listings Radio Amateur Callbook, which has over 360 000 listings, and the 1981 United States Callbook, with 398 829 radio amateurs listed. Both these callbooks also contain such useful information as QSL managers, world call prefixes, international postal information, standard time charts, world QSL bureaus, etc.

The 1981 print of the Radio Amateurs Kit of Maps, including a world map, US Great Circle map and a United States map, plus an atlas, is also available from GFS. All maps and the atlas are printed in four colours with zones and call prefixes marked.

The US Callbook is priced at $20 plus $3.50 postage, the Foreign Listings at $19 plus $3.50 postage, and the Kit of Maps is $6 plus $2 postage.

All books and maps are obtainable from GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic. 3132. (03)873-3939.

FM for 28 MHz?

Whilst AM seems all the rage on certain segments of the ten metre band in this part of the world, US amateurs may be moving toward FM, as is very popular on the VHF/UHF bands.

Colt Communications in the US are reported to have released a range of 22 and 40 channel 27 MHz CB rigs for the European market — read British CB — at the Chicago Consumer Electronics Show last June, which will no doubt find their way on to 28 MHz in the US, where there is some limited FM operation, and the UK.

Colt are said to be following up with 28 MHz versions for the amateur market. (HR Report).

Spread spectrum transmissions for US amateurs

The American Federal Communications Commission announced a Notice of Inquiry and Proposed Rulemaking on July 1, proposing spread spectrum transmission for US amateurs.

This follows experiments on the HF bands by a group of US amateurs operating under a temporary permit back in May.

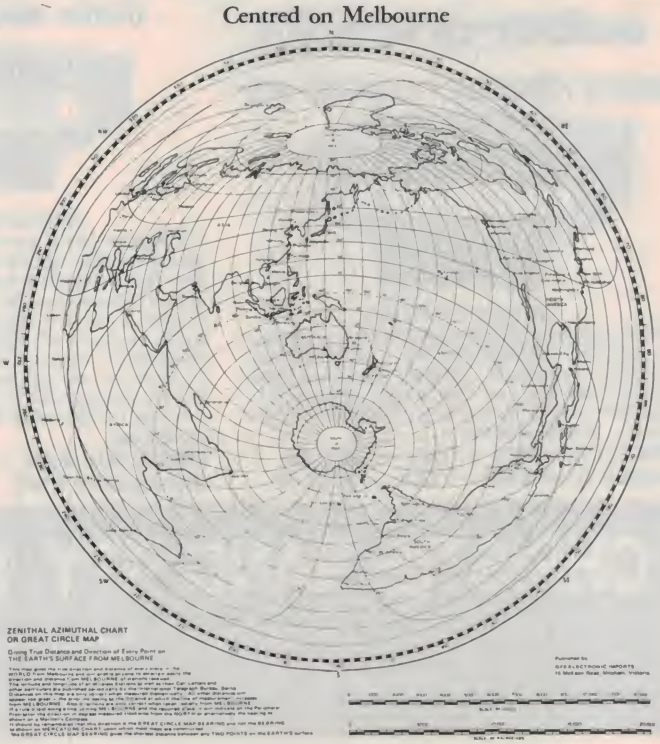
The FCC proposes limiting the use of sophisticated broadband techniques to the 50, 144 and 220 MHz US amateur bands by Advanced and Extra Class licensees only. Principal limitation is that emissions be contained within the given band.

Wonder when our Communications Dept. will consider such things?

Info from HR Report, July 10

GREAT CIRCLE MAP

Centred on Melbourne



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19 key easy to use keypad. For frequency input, memory recall, scanning etc.

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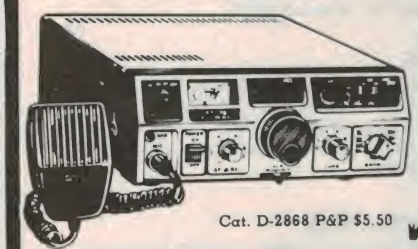
EXCLUSIVE: Receiver pre-amp built-in

High power Mobile That's The FT7B



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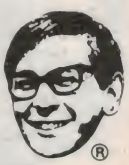

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This small book takes the mystery out of microprocessors. It starts with a design for a simple computer described in language easy to learn and follow. The shortcomings of this basic machine are then discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions.
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For the electronic music enthusiast, an invaluable reference. This book is full of circuits and information on how to build analogue delay lines, sequencers, VCOs, envelope shapers, etc, etc. The author takes a clear and logical approach to the subject that should enable the average enthusiast to understand and build up what appears to be a quite complex instrument.
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A book to suit the dyed-in-the-wool experimenter. Though primarily concerned with VMOS power FETs and their applications, power MOSFETs are dealt with too in a chapter on audio circuits. A number of varied and interesting projects is covered under the headings: Audio Circuits; Sound Generator Circuits; DC Control Circuits and Signal Control Circuits. Learn while you build.
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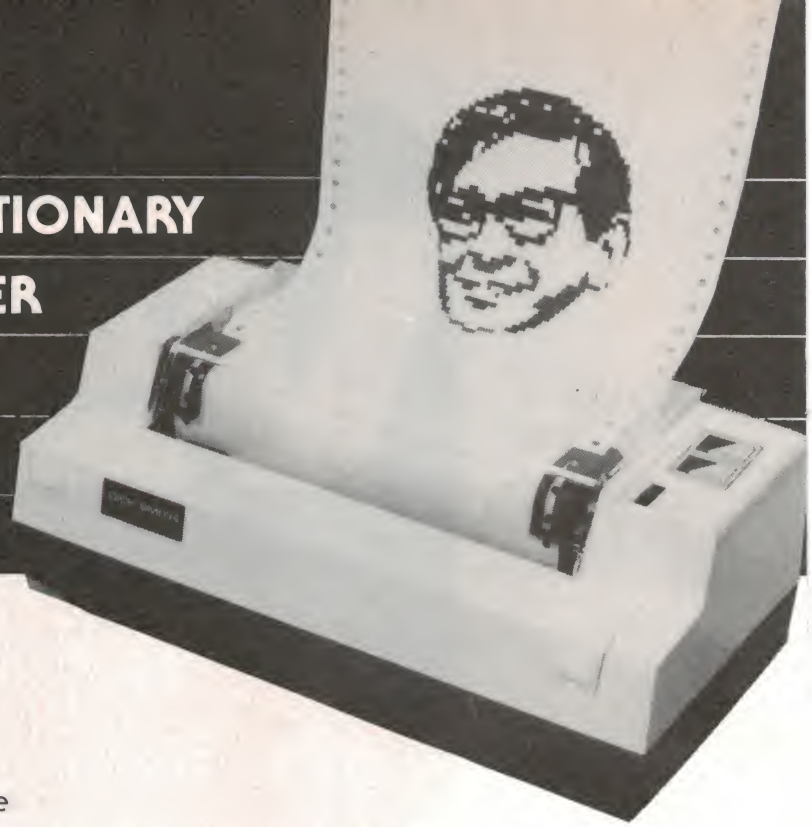
INTRODUCING A REVOLUTIONARY DOT MATRIX PRINTER WITH JUST ONE HAMMER. AT AN INCREDIBLE PRICE— JUST $495.



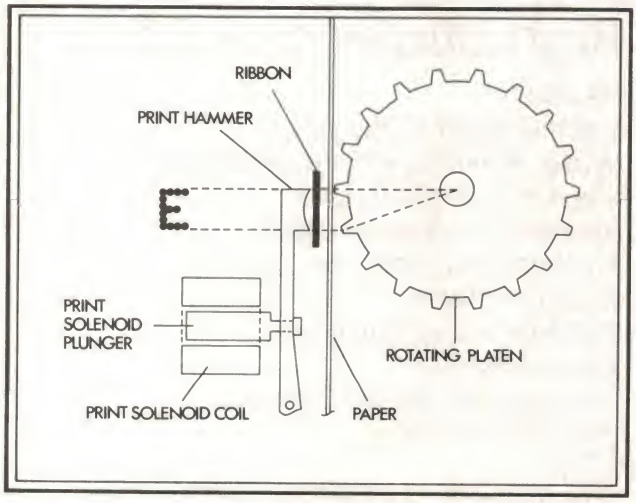
Cat. No. X-3252 P&P $5.50

The Uni-Hammer Replaces Seven . . . or More.

Revolutionary? We don't know what else to call it. An impact printer with a single rugged hammer, rather than the seven or more individual solenoids and print wires found in conventional dot matrix printers.

At an incredible unit price of $495!

Because of the unique Uni-Hammer design, the X-3252 is smaller and simpler than other dot matrix printers yet costs considerably less. Which makes it a natural for the personal or small business user who wants a quality, reliable impact printer at the lowest possible price.



A Product of the Seiko Group

It took a company such as the Seiko group, world's largest watch manufacturer, with vast experience in the design of small, intricate, precision products, to come up with a totally new concept in dot matrix printing.

How the Uni-Hammer Works

The X-3252, which prints both graphics and alphanumerics, uses a rotating platen with protruding splines positioned behind the paper (see diagram). The character or graphics image is created by multiple hammer strikes in rapid succession as the print head advances across the paper. The precision gear train assures exact positioning of the print hammer relative to the splines on the platen, to provide excellent print quality.

A Complete Printer

The X-3252 has features comparable to printers selling for thousands of dollars. These include upper/lower ASCII character sets, ribbon cartridge, 80 columns at 12 characters per inch, adjustable tractor feed, original and 2 copies, 30 characters per second, and full graphics with a resolution of better than 60 dots per inch in both horizontal and vertical axes.

Centronics Interface

The X-3252 DOT MATRIX PRINTER has a Centronics-type parallel data interface and is compatible with System 80, TRS-80, Sorcerer and Apple computers etc.

Fan Form Paper

2,000 sheets continuous fan form paper to suit printer

Cat. X-3254 .... **$27.50**

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496Y	1 60
505	1.65
509	1.40
539	1 20
561	1.80
562	85
564A	1 40
608	1 50
628A	65
634	1 95
636	4 50
639	1 15
640	1 15
641	1 15
642	1 30
661	1 35
670	2 45
671	2 55
673	70
678	1 75
682 O	2 40
683	1 15
684	1 35
697	2 10
706	4 20
715	1 90
719O	90
720	1 15
726	1 55
733P Q	70
740	7 60
748	3.00
758	8 65
769	3 90
794	2.45
816	1 90
844C	75
844D	75
885	2 15
950	3 00
969	6 30
999	65
1015Y	85
2SB	
56	80
77	95
156	1 90
187	1 00
324	95
337	4 50
364	1 50
405	1 35
407	4 20
415	1 10
434	3.65
440	2 10
449	4 80
463	3 60
471	4 80
474	3 15
492	2 40
504	16 60
506	21 60

TRANSISTORS

	$ c
2SB	
509	6 30
511	2 20
512	4 60
514	2 55
525C	1 45
529	1 70
534	2 20
536A	3.25
536B	3 85
541	9 60
544	1 10
549	3 35
554	16 80
555	15 00
557	12 95
562	1 80
596	3 65
617	6 00
618A	9 00
647A	2.00
688	6.00
764	1 20
2SC	
281	1 90
371	75
372Y	70
373	60
374	75
380	65
381Y	90
382	1 70
383	1 50
385A	1 45
387A	1 45
388A	1 15
398Y	2 30
399	2 15
403C	1 30
454L	50
458B C	60
460	55
461	95
485	5 50
494	9 30
495Y	1 60
496	3 70
498	3 60
509Y	1 75
535A	70
536D	50
538A	1 50
562	1 95
563	1 95
605	2 35
620C D	65
641	1 30
643A	8 65
644	70
681	7 90
685	3 00
693	55
710C	80
710D	80
711A E	55
712C	70
717	2 00
728	2 75
730	9 90
731	15 35
732	65
733	65

TRANSISTORS

	$ c
2SC	
734	90
735Y O	1.00
738	75
756	7 30
761	1 90
762	1 90
763D	80
776	9 40
780	1 95
781	6 50
782	11 20
783	6 75
784R	2 50
785	85
789	3 85
790	2 95
791	7 00
792	6 75
793	6 30
799	6 25
815	90
828A	90
828O P	90
829B C	75
838H	85
839F H	60
871E	80
900E	70
900F	70
900U	70
901A	7 80
926	1 35
929	65
930	65
933	1 40
935	8 45
940L	6 40
941	1 20
943	2 30
945A Q R S	70
983	2 65
1000GR	1 10
1014C-2	1 65
1014D	1 65
1017	1 75
1018	3 80
1024	3 65
1047	75
1060	1 70
1061A B C	1 60
1061D	1 60
1070	2 95
1096	1 40
1098	1 95
1106	9 40
1124	2 90
1162	1 15
1172B	18 60
1173	1 70
1175	85
1210	70
1213	80
1214	1 90
1215	70
1222	70
1226A	1 25
1239	9 70
1260	6 40
1306	6 65
1307	7 85
1317	75
1318R	90

TRANSISTORS

	$ c
2SC	
1327T	70
1328	1.20
1335	1 15
1344	75
1346	1.50
1359	90
1360	1.05
1362	1 70
1363	1 15
1364	90
1368	1.75
1383R	1 30
1384Q R	1 45
1393	1 60
1398	1.90
1419	2.45
1446	2.00
1447	3.95
1448	3.70
1449	2 75
1450	5.50
1475	1 90
1506K L M	1 55
1507K L M	1 55
1509	2.60
1550	1 95
1567	2 35
1568	2 35
1569	4 00
1571	65
1583	2.10
1589	5.30
1591	39.70
1620	19 80
1647	70
1674	70
1675L	70
1678	3 75
1683	3.10
1685	75
1687	95
1688	1 15
1740	2.90
1760	3.20
1775E	1 15
1810	5.85
1815GR	1.00
1815Y	1.00
1816	5 40
1827	3.90
1845	1.50
1846R	1 40
1848	1 95
1856	1 20
1906	1 75
1908	95
1909	7 50
1923R	85
1942	12 90
1945	14.00
1947	15 85
1957	1 35
1964	3.55
1967	26 60
1968A	39.65
1969C H	6.90
1973	1 85
2053	3.15
2055	3 15
2073	2.85
2074	2.00
2075	4.95

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	$ c
2SC	
2076	.70
2086	1.05
2098	10.00
2099	26.90
2116	4.45
2131	9.20
2132	68.25
2146	4 55
2152	35.60
2166	3.65
2229	1.65
2233	4 35
2274	85
2320	65
2327	9.80
2724	70
2SD	
30	1 30
91	8 10
93	8 40
111Y	10.50
113Y	26 10
180	5.95
187R	1.35
200	6.30
213	20.50
227	2 50
234	1.90
235Y	2.25
288	2.00
300	13.90
313E	1.80
315	3.40
318	4.00
325	1 60
330	1 75
350A	9 80
355C	1.05
359	1 80
380	9 70
388	6.30
389	3 60
400	75
415	2.70
424	18.90
426	15 60
467	1.85
471	1 10
525	2 90
526	3 90
586	4 85
587SB	3.65
588A	8.25
667A	2.00
863	1 15
2SK	
19GR	1.45
19Y	1.45
30Y A	1 30
33F	1 40
34E	1.25
40C	1 35
41D	1.05
41F	1.80
42	3.85
44	1.95
49H	1.85
54B	1.05
55D	1.05
55E	1.05

TRANSISTORS

	$ c
2SK	
68 L	1.00
107	1.60
120	1 45
125	3.75
128	1.60
150	3.70
3SK	
37	5.85
39Q R	4.10
40M	5.50
41L	4.95
45R	2.35
48	4.95
51-03	3.20
54B	3.05
59GR	2.90

INTEGRATED CIRCUITS

	$ c
AN	
214	5.25
217	4.10
240	14.70
272	8.10
315	7.95
360E	1.95
612	5.10
6552	2.95
7140	5.75
7151	6.95
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501	9.25
511	9.25
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CA	
3012	8.20
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107	33.60
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1156 W	4.05
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1322	6.20
1329	4.75
1338	11.20
1339A	7.40
1342	5.45
1366 W	7.50
1366 WR	7.00
1367	11.40
1397	14.70
LA	
1201	2.90
4102	4.25
4420	4.10
4430	3.80
LM	
386N-1	1.30
M	
5115PR	12.90
5152L	5.15
51202L	3.10
51513L	14.40
58476	29.95

INTEGRATED CIRCUITS

	$ c
MB	
3705	4.80
3756	6.10
MC	
14001	1.85
14001BCP	1.60
14011	.65
14015	2.60
14016B	2.90
14028	1.90
14049	1.35
14066	1.65
14071	.85
14076	2.55
14511	3.10
14526B	6.95
14532	3.35
14543	4.30
14568B	12.55
1458	2.90
1496 G	2.95
3340	5.65
4044	5.95
4069	1.35
MHW	
710-003	52.00
MM	
5369 AA/N	5.95
5387 AA/N	9.80
5799 NBR	39.95
74C 93	6.15
MSM	
100RS-8642	4.35
105R-7261	4.35
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NDC	
40013	15.95
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7261A	9.30
NJM	
4558D	2.85
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02 A	15.85
RC	
4558	2.30
SL	
1626	11.50
1640	8.80
SN	
74161	1.95
74184	9.95
76115	3.65
76600P	5.55
TA	
78	6.55
7045	5.75
7055P	5.85
7060P	2.20
7061P	2.75

INTEGRATED CIRCUITS

	$ c
TA	
7062P	4.70
7063P	2.10
7069P	4.45
7073P	10.25
7089M	7.30
7102P	11.55
7108P	3.85
7120P	1.80
7130P	4.60
7141AP	12.00
7146P	12.00
7203P	9.50
7204P	4.85
7205P	4.55
7215P	12.00
7222AP	6.25
7227P	24.30
7310/C3001AN	4.40
7310/C3001AT	3.35
7310P	2.95
7313P	3.65
TBA	
810 SH	5.00
TC	
4508	11.75
5032P	16.25
5080P	11.80
5081P	8.45
5082P	8.45
9100	13.95

INTEGRATED CIRCUITS

	$ c
TMS	
1943 NL	16.00
uA	
703	3.65
UHIC	
005	9.95
uPC	
78L05	1.75
78L06	1.75
78L062AWC	2.70
78L62WV	2.70
78L08AC	1.75
30C	5.45
41C	5.40
555H	1.60
562C	9.45
566H	1.25
575C2	4.95
576H	7.30
577H	1.60
587C2	6.95
592H2	1.55
1001H2	5.20
1020H	11.50
1025H	6.60
1156H	4.85
1181H	7.85
1182H	7.85
1350H	6.00
uPD	
858C	10.95

INTEGRATED CIRCUITS

	$ c
UP	
477-C12	69.00
Curtis	
8044	24.95

CRYSTALS

1.0000 MHz	11 95
3.579545	7 50
7.4015	6 80
7.8015	9.90
9.555	4.80
9.565	4.80
10.000	6.95
10.020	4.50
10.0525	6.35
10.240	6.95
10.245	11.50
10.692	6.95
10.695	6.95
12.800	11.50
16.965	6.20
17.065	6.20
17.115	6.20
17.165	6.20
17.215	6.20
21.145	11.50
32.520	11.50
33.020	11.50
33.520	11.50
35.395	11.50
35.500	11.50
35.552083	11.50

CRYSTALS

	$ c
35.895 MHz	11.50
35.96875	11.50
36.380	11.50
36.395	11.50
37.36875	11.50
37.76875	11.50
39.16875	11.50
40.4875	11.50
40.9875	11.50
41.000	11.50
41.4875	11.95
41.500	11.50
41.9875	11.50
42.000	11.50
42.500	11.50
43.500	11.50
44.000	11.50
50.77666	8.30
50.79666	8.30
50.80666	8.30
50.81666	8.30
50.82666	8.30
50.84666	8.30
50.85666	8.30
50.86666	8.30
50.87666	8.30
52.486666	10.20
52.4966	10.20
52.506666	10.20
52.5166	10.20
52.526666	10.20
52.5366	10.20
52.546666	10.20
52.5566	10.20
52.5666	10.20

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74 Prospect Road, Prospect, SA 5082
Phone (08) 269-4744

Please send:

Quantity	Part Number	each $	each c	Total $	Total c

bankcard

ORDER TOTAL $
Plus $1.50 post/pack
PAYMENT ATTACHED $

Bankcard No

Signature

Name

Address

Pcode

ET1 9/81

In the world of personal computers there is just one that is known as the best: the PET

NOW 16K RAM AT 8K PRICE $999

The Commodore PET has become the standard for the Personal Computer Industry.

The Pet is completely integrated, with the processor, memory, keyboard and visual display unit contained within a robust housing, allowing easy transportation with no interconnecting cables necessary. In order to retrieve and save your data and programs, a storage device is used which operates like a cassette recorder, with your information recorded reliably on standard cassettes. The PET has 16k bytes of RAM. Optional equipment permits expansion to 32k. Also, it has 14k bytes of ROM.

The Pet communicates in BASIC— the easiest computer language. Easy to learn and easy to use, BASIC has now become the standard for personal computers, with literally thousands of programmes available. The PET is also programmable in machine language, allowing more efficient use of the system.

The full-size keyboard is capable of producing letters, numbers and graphic symbols. Upper and lower case is standard. Characters appear on the screen in a pleasant green colour designed to reduce eye fatigue and may be displayed in normal or reverse print.

PET's IEEE-488 Bus- just like H.P.'s mini and full size computers — permits direct connection to over 200 pieces of compatible equipment such as counters, timers, spectrum analysers, digital voltmeters and printer plotters from H.P., Philips, Fluke, Textronix and others.

The full range of Commodore Disk Drives and Printers are plug-compatible with the PET and a comprehensive range of cassette and disk based programmes are available through the extensive network of Commodore Dealers.

APPLICATIONS

The Commodore PET is a creature of many faces. Its applications are limited only by the user's imagination.

The future of the PET is virtually unlimited; its present capabilities are already many and impressive. As a personal computer, the PET can teach languages and mathematics; play games; create graphic designs; store meal recipes and change number of portions; maintain budgets, personal records and checkbooks; operate appliances and temperature controls.

As a management tool, it delivers the information the executive needs, in the form he can use, and available to him alone. Trend analyses charts and graphs can be almost instantly available.

The professional may use the PET for maintaining appointment schedules, recording income and expenditures and filing all the specialized information and forms he may need to make his work more efficient — from medical records for a doctor to income tax computations for an accountant.

The engineer, mathematician, physicist, has a tool far superior to the very best programmable calculators yet developed... at a cost that is comparable...and with almost infinitely greater versatility.

And the businessman has a computer that can maintain inventories, keep payroll records, operate accounts payable and receivables, issue cheques and handle correspondence.

Commodore PET 4016 Computer Technical Specifications.

Computer/Memory

Read/Write Memory (RAM) 16K bytes available to the user.
Read Only Memory (ROM) 14K bytes in total, divided into:
8K BASIC interpreter available immediately you turn on your PET.
5K Operating System
1K Test Routine
The 6502 micro-processor chip makes the PET one of the fastest and most flexible BASIC systems. Significant features of Commodore BASIC are:

- 960 simple variables
- 960 integers
- 960 string variables
- 960 multi-dimensional array fields for the above 3 types of variables
- Up to 80 characters per program line with several statements per line
- Upper/Lower case characters and graphics capability
- Built in clock
- 9-digit floating point binary arithmetic
- True random number generator
- Supports multiple languages; machine language accessibility

Keyboard

74-Key professional keyboard.
Separate calculator/numeric pad.
Upper-case alphabetical characters with shift key to give 64 graphics characters.
Can be set for lower case and shifted upper case characters.

Screen

40 characters wide by 25 lines (1000 characters in 8 × 8 dot matrix).
23 cm screen phosphor screen.
Brightness control.
64 ASCII plus 64 graphics characters.
Blinking cursor with full cursor control, including programmable control.

Screen editing capabilities

Full cursor control (up, down, left, right).
Character insert and delete.
Reverse character field.
Overstriking.
Return key sends the entire line to the CPU regardless of cursor position.

Input/Output

8 bit parallel input/output port.
IEEE-488 Bus (HP-IB and IEC Bus) allows up to 12 other peripherals to be connected.
Two cassette ports.
Video signals for additional displays.
Serial output port.

Technical Data

Dimensions: Height 355 mm (14″), Width 419 mm (16.5″), Depth 185 mm (18.5″), Shipping Weight 20.9 kg (46 lbs).
Power requirements 240V ± 10%, Frequency 50 Hz, Power 100 Watts.

Commodore BASIC

APPEND	GOSUB..RETURN	STOP	SPC
BACKUP	IF..THEN	SYS	LEFT$
CLOSE	INPUT	VERIFY	RIGHT$
CLR	INPUT #	WAIT	MID$
CMD	LET		CHR$
COLLECT	LIST	SGN	ASC
CONCAT	LOAD	INT	LEN
CONT	NEW	ABS	VAL
COPY	ON..GOSUB	SQR	STR$
DATA	OPEN	SIN	TI
	POKE	COS	TI$
DEF/FN	PRWT	TAN	ST
DIM	READ	ATN	DS
DIRECTORY	RECORD	LOG	DS$
DLOAD	REM	EXP	+
DOPEN	RENAME	AND	−
DSAVE	RESTORE	OR	*
END	RUN	NOT	/
FOR/NEXT	SAVE	TAB	↑
GET	SCRATCH	POS	π

Commodore microcomputers

For details of your local dealer send to: **Commodore Information Centre, Box 336, Artarmon, NSW 2064. Australia. Phone (02) 437 6296**

Mlvl 469

COMPUTING TODAY

M68000 development agreement

Two of the world's major electronics manufacturers, Philips/Signetics and Motorola, have agreed to a five-year pact for the development of 16-bit microprocessors.

Their goal is a large family of integrated circuits, software products and allied development tools which will be fully compatible with each other.

Philips/Signetics will alternate-source Motorola's M68000 microprocessor family and produce pin-compatible products as well as develop new products which may be manufactured by both participants. At least three peripheral data communications chip designs will be added to the M68000 line by the end of this year, and by 1983 it is anticipated that twelve or more new designs will have been added to the family.

Both Motorola and Philips/Signetics will produce software, including operating systems, language processors and application packages, as well as development system tools.

While the agreement covers the development of circuits, hardware, software and support tools, manufacturing, marketing and sales will still be handled competitively, according to a spokesman.

Signetics is a wholly owned subsidiary of US Philips Corporaton, the Electronic Components and Materials Division of which is Europe's largest producer of integrated circuits. Motorola Inc is one of the world's largest producers of communications and automotive electrical equipment, military and aerospace electronics, and semiconductors.

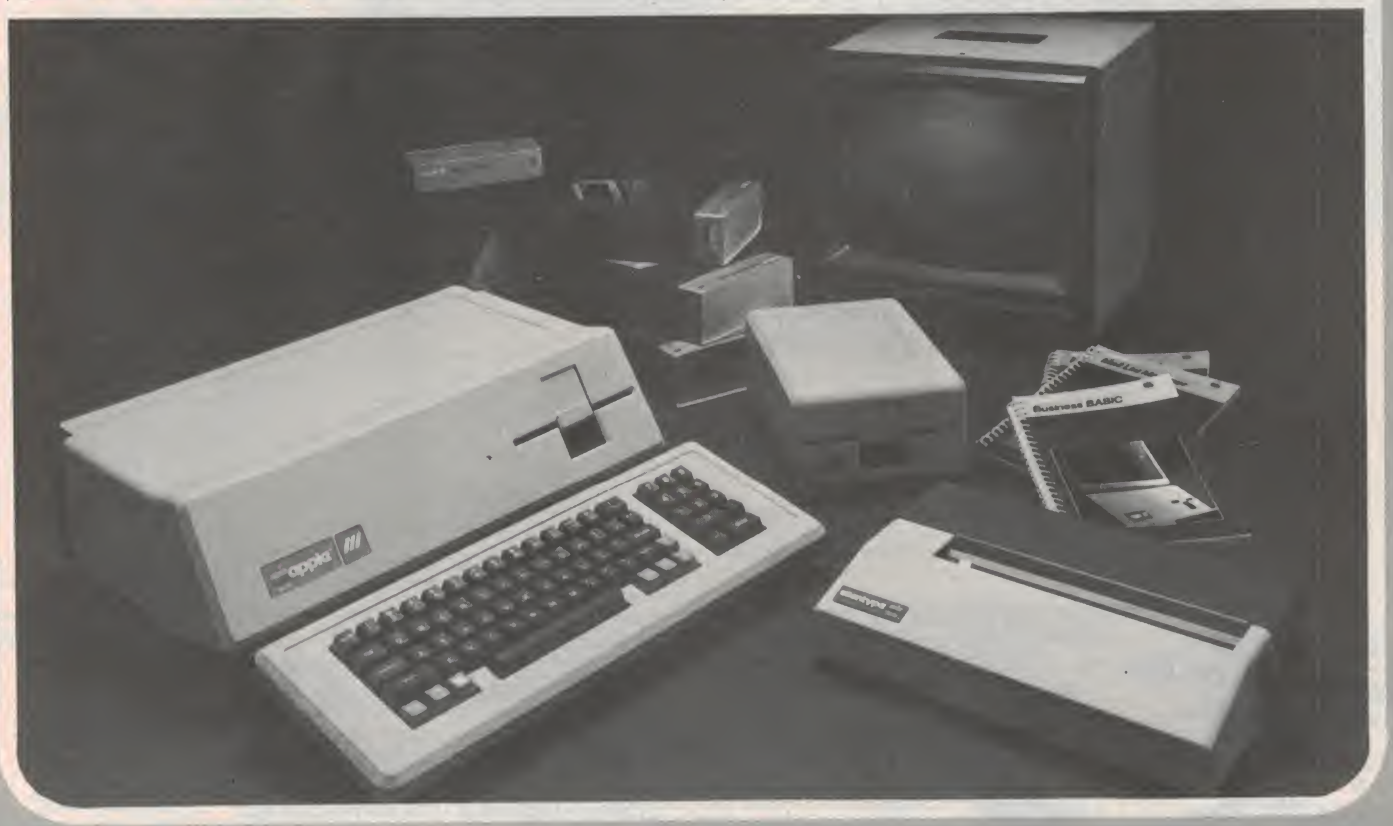
Apple marketing rationalised, Apple III on the way

Electronic Concepts have been appointed the 'master distributor' for Apple computers in Australia, and they will be marketing the computers and peripheral products through their dealer network and Computerland stores.

Delta Communications of Hong Kong are also 'permitted' to supply Australia and are the major supplier of Apple products in New Zealand.

The recent rationalisation of the marketing network now allows the US manufacturer to supply Apple products direct to Australia, according to a press briefing in July. Electronic Concepts currently has a string of 48 dealers and this is expected to grow to about 75-80 by the end of the year. In addition, there are seven Computerland stores – the Computerland chain is now a separate entity to Electronic Concepts – and the number of stores is expected to double by Christmas.

The long-awaited Apple III is expected to be released this month or next and features flexibility and expandability to meet growing user needs, according to the Apple publicity. The new computer will also herald the launch of exclusive Apple peripherals. More later...



AT LAST!

a computer every home can afford

NEW LOW PRICE $695* was $750

the brilliant DICK SMITH System 80 computer

*Monitor and expantion unit not included.

Outstanding value for money . . . plus programs especially written for Australia!

Australia's fastest selling computer — and small wonder! Compare the System 80 with its competitors: you'll see why!
And now it's even better: with now features to make your computing even better.
Join the thousands of System 80 users now: turn yourself into a computer expert!

Compare the features – then compare the prices!

PARAMETER	SYSTEM-80	TRS-80 (Level II)
1 CPU type	Z-80	Z-80
2 Speed	1.7MHz	1.7MHz
3 S-100 compatible (with expansion unit)	Yes	No
4 Amount of RAM (basic computer)	16K	16K
5 Built-in cassette recorder	Yes	No
6 Built-in video RF modulator (use with any TV)	Yes	No
7 Capacity of BASIC ROM	12K	12K
8 Cassette recorder ports (basic machine)	2	1
9 Motor control for cassette recorders	Yes (2)	Yes (1)
10 Cost of basic unit with 16K RAM including monitor and cassette recorder	**$844.50**	**$1169**

*The basic SYSTEM 80 computer costs only $695. As this computer has an output for direct connection to your TV set a video monitor, as a separate entity, is not required, making the possible savings on Tandy prices even greater . . .

SPECIAL THIS MONTH ONLY $480!!

UNLEASH THE FULL POTENTIAL OF YOUR COMPUTER . . .

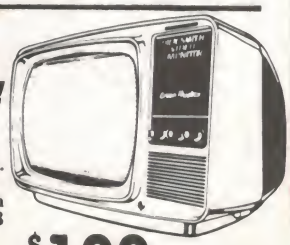
To get the most from your computer, you need to add peripherals. This expansion unit gives you this capability. Made to world standard S-100 system, so you aren't tied to any one supplier for your add-ons.

S-100 EXPANSION

$499

Cat. X-4010

LOOK AT DICK'S PRICE FOR A GREEN PHOSPHOR MONITOR!



for the professional user — or even the hobbyist who uses his system for long periods, a Green Screen Monitor is a must. Superb definition, with ultra-sharp print that can be looked at for hours longer with less fatigue. Cat. X-1198

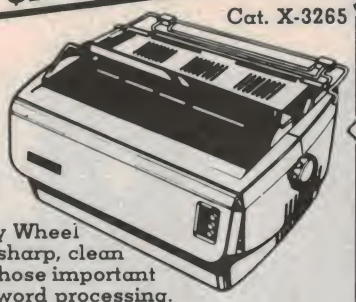
NOW WITH IN-BUILT AMPLIFIER FOR PROGRAMS WITH SOUND EFFECTS.

$199

NOW! A WORD PROCESSING QUALITY PRINTER FOR UNDER $2000!

Cat. X-3265

DAISY WHEEL PRINTER



The Dick Smith Daisy Wheel printer delivers ultra sharp, clean copy — it is ideal for those important applications such as word processing. It accepts standard office stationery (letterheads, etc) — or continuous stationery if required — up to 400mm wide. It can produce proportional printing for that 'professional' look. The Daisy Wheel can use standard Diablo daisywheels and ribbon cartridges — so a wide range of fonts is available. Centronics-type parallel interface — so it is suitable for most of the currently available microcomputers.

For quality and value for money, you can't beat the Dick Smith Daisy Wheel Processor Printer!

only $1995

RUN A PRINTER WITHOUT AN EXPANSION UNIT

The low-cost way to obtain a Centronics-type printer port from your System 80 computer without need for an S-100 Expansion Unit.

Cat. X-4013 **$49.50**

DISK PRICES TUMBLE!

133mm (5¼in.) minifloppy diskettes. Superb quality.

Hard Sectored (Cat. X-3505)

Soft Sectored (Cat. X-3510)

$4.95 each

TOP VALUE!

TWICE THE STORAGE OF A TANDY DRIVE — AND IT COSTS LESS!

Cat. X-3208

Dick Smith MICROPOLIS™ Disk Drive

The Tandy disk drive with 35 tracks gives 87.5K of storage and costs $699. If you want approx. the same storage as the Micropolis™, you need to spend $1378. The Micropolis™ has 77 tracks with 2.5K per track, a total of 192.5K of storage on one disk drive!

THAT'S TWICE THE STORAGE FOR A LOWER PRICE!

only $649

Look at this incredibly priced printer!

Amazing value! You've seen the price of all the other printers — now look at this one. Unique single hammer system gives unbelievable print quality; takes up to 204mm paper. Ideal for business or hobby computing.

Cat. X-3252 **$495**

25 PIN D-TYPE CANNON SOCKET

Used in conjunction with P-2690 25 Pin D-Plug and P-2692 Backshell, to suit both the plug and socket. High quality gold contacts.

Cat. P-2691 **only $7.95**

GREAT NEW SOFTWARE

HIGH QUALITY WORD PROCESSING ON YOUR SYSTEM 80 WITH

WORP-9 PROGRAM

WORP-9 provides a host of features including unlimited text insertion, ability to print mailing labels and merge name and address file with a standard form letter. Complete with easy-to-read User Manual. Requires 32K and at least one disk drive.

Cat. X-3761 **$299**

I wouldn't be here, if I could have collected sooner

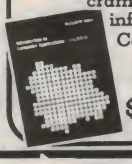
If your're in business, you'll know the importance of monitoring your cash flow. Don't be caught out! This program gives you this information without hours of labour normally associated with such a task. Features include: Five types of transactions, invoices, credit notes, cash receipts, journal debits and credits; General invoices and statements; Automatic end-of-month reset plus many other outstanding features.

Cat. X-3756

ACCOUNTS RECEIVABLE FOR SYSTEM 80/TRS-80.

Introduction to Computer Applications

The best guide to BASIC programming we've seen. 400 pages crammed with information.



Cat. B-2368 **only $18.95**

SORCERER SOFTWARE

WANT ANIMATED GRAPHICS?

This system creates and displays graphics and effecting animation with BASIC programs. Includes: three demonstration programs, separate character maker program and 28 pages of documentation. Cassette.

Cat. X-3666 **$29.95**

SAVE PROGRAMMING TIME WITH 'DEBUG'

Machine language debug package, designed to trouble-shoot language programs.

Cat. X-3624 **$17.95**

Z-80 DISASSEMBLER

Translates back into assembly language. A BASIC program, can be used to examine ROM PAC BASIC interpreter. Cassette.

Cat. X-3622 **$17.95**

Got a computer problem?

We're only a phone call away. Our Hotline provides a level of service and advice without equal in Australia's small computer industry.

Remember, we're here to help you.

DICK SMITH COMPUTER HOTLINE (02) 888-2002

DICK SMITH Electronics

NSW AUBURN 648 0558 ● BLAKEHURST 546 7744 ● BROADWAY 211 3777 ● BROOKVALE 93 0441 ● CHULLORA 642 8922 ● GORE HILL 439 5311 ● NORTH RYDE 888 3200 ● PARRAMATTA 683 1133 ● SYDNEY 290 3377 ● TIGHES HILL 61 1896 ● WOLLONGONG 28 3800 **ACT** FYSHWICK 80 4944 **QLD** BURNADA 391 6233 ● CHERMSIDE 59 6255 **SA** ADELAIDE 212 1962 **VIC** MELBOURNE 67 9834 ● RICHMOND 428 1614 ● SPRINGVALE 547 0522 **WA** CANNINGTON 451 8666 ● PERTH 328 6944

Mail Order Centre: PO Box 321, North Ryde 2113. Phone: (02) 888 3200 DSE/A023/LM

Printout

New Australian group – Cash Computers

Cash Computers, an offshoot trader from the 6502-based microcomputer manufacturer Computer Automation and Hardware, claims to offer personal computer enthusiasts the same deals on hardware that computer manufacturers are able to tender for from suppliers.

High-quality equipment is imported from the US, selected by Cash's US partner for proven performance and competitive prices. They hope thus to offer Australians the benefits of the large-scale US markets – without the large-scale price tag.

Cash Computers sell the latest Apple II-plus computers with internal lead shielding to reduce RF noise, along with all the latest motherboard improvements. They claim extras like this will push up the price of the Apple when they finally filter through to the rest of the Australian market – but they are offering them now!

Also available is a comprehensive range of plug-on peripherals enabling use of Pascal and CP/M as well as communications cards and software with which the Apple can interact with a mainframe computer.

Cash has a range of 5¼" and 8" floppy and hard disks, configurable to any Apple II, TRS80 and S100 system. They also have 8" floppy and hard disk drives which will run on the Apple II, completely invisible to the system and alongside the existing 5¼" disk drives. Double density and single or double-sided, these disk drives give up to 2.2 Mbytes of storage – and Cash claim that the price won't send you bankrupt.

Cash Computers intends to keep prices low by avoiding high-cost street-level showroom selling, so all enquiries should be made by post or phone. Contact either Tony Bruck or Tony Rankine on (02)387-3541, or write to PO Box 171, Bondi Junction NSw 2022.

Bubble memory recorder

Memodyne Corporation of the USA recently introduced a state-of-the-art read/write recorder utilising a plug-in bubble memory cassette as the storage medium.

The Model BMR8 is designed to withstand harsh environmental conditions and is said to deliver reliable data on a removable, non-volatile, solid state medium that may be used over and over again without any degradation of performance.

The Model BMR8 features:

- Recording speeds of up to 19 200 baud or 2000 bytes per second.
- Capacity of each bubble cassette – 64 000 bits.
- an error rate of 1 bit in 10^{10}.
- A memory that remains undisturbed when power is turned off or when the cassette is removed.
- CMOS logic throughout.

For further information contact Andrew Reid, Marketing Director, The Dindima Group Pty Ltd, PO Box 106, Vermont Vic 3133. (03)873-4455.

Microcomputers in UK schools scheme

The British Minister of Information Technology, Mr. Kenneth Baker, has given details of a scheme, worth up to STG£4 million, to place at least one microcomputer in every British secondary school by the end of 1982.

He stated that this programme (together with the Education Department's £10 million microelectronics education programme) is aimed at today's 'keyboard generation' of schoolchildren. It will provide the instruction and eagerly awaited hardware which is so necessary to prepare them for the future.

Under the scheme the Department of Industry will match funds provided locally towards the purchase of a microcomputer for each eligible school. Local Education Authorities wishing to take advantage of the scheme will be responsible for finding their local contribution and it is hoped that local industry, parent-teacher associations and the schools will provide assistance in raising the required funds.

Brian Dance

Personalised tutoring with micros

Lothlorien Farming is a new company whose aim is to make available instructive, enjoyable, useful and very personalised tutoring systems for microcomputers.

They maintain that there has as yet been very little written in educational programs to give a student an immediate and fulfilling interaction with the computer, with rapid feedback in a tutorial setting.

Each of their programs includes one or more basic tutorial units already written into it. With the built-in, easy to use editing facilities the user can also enter his own material from his own texts, and thus a tailor-made set of units for each user can be built up to test and revise old material and to introduce new work, extending the knowledge available, according to Lothlorien Farming.

Programs at present available include:

- Geography Tutor: an interactive, high-resolution graphics program with testing and atlas modes.
- Cell Biology: again interactive with high-resolution graphics, providing testing and anatomical atlas modes.
- Microbiology Tutor/Analysis: identification and classification through interactive user responses.
- Spelling Tutorials: remedial to high-grade spelling, vocabulary and speed reading exercises.
- Foreign Language Tutor: vocabulary builders with English/Language or Language/English mode, available in French, German, Indonesian, Latin.

For sheer enjoyment Lothlorien also have The Caves of Mordia, a sophisticated game of adventure and strategy especially dedicated to all those hooked on dungeons, dragons and/or Tolkein.

More details are obtainable from Lothlorien Farming, PO Box 1033, Sydney NSW 2000. (02)398-4023.

Was the System 80 'designed for Australia'?

Apparently, yes. Dick Smith wanted a low-cost, TRS80-compatible computer with features he'd learned Australian users wanted, and approached an Asian manufacturer.

After some arguing back and forth, a few production changes, etc, he got what he wanted and launched the first of the System 80s on the market here.

It took off, as history shows. A little market research about what computer users here were buying and why, and what they were looking for in a system, paid off. The manuals and BASIC book were Australian-written for the System 80 too.

The manufacturers launched the system in Europe and America as the Video Genie subsequent to the release of the System 80 here.

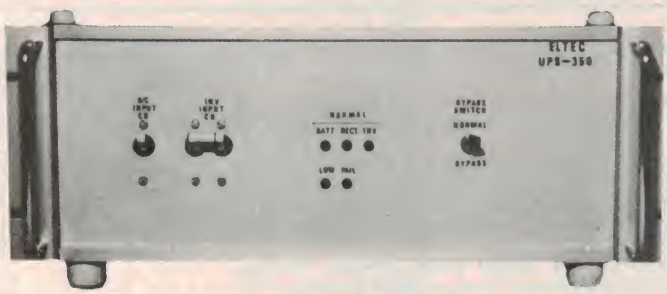
To this day, the System 80's two-cassette data storage and retrieval capability and video plus RF output are unique in the computer market.

Unfortunately, we learned the story too late for inclusion in our review in the July issue.

Tandy and computer education

Recognising that tomorrow's world is going to be extremely reliant on the small, versatile microcomputer, Tandy has stated a determination to provide the education necessary to give people essential computer operating and programming skills.

Tandy recently set up a Computer Education Marketing Division, headed by ex-lecturer and teacher Mike Lehman, which will primarily be involved with introducing computers at primary, secondary and tertiary levels of schooling, and with making teachers aware of the applications of microcomputers in the classroom.



Uninterruptible power supply for micros

DeForest Software recently announced their Australian-designed uninterruptible power supply, suitable for all microcomputer systems.

The Eltec UPS backs up the commercial line with a battery reservoir and a conversion system that produces continuous top-quality ac power. The reservoir is said to typically have enough power to keep equipment in operation for five minutes to fifteen hours, depending on secondary storage, when the ac power interruption occurs.

Further information may be obtained from DeForest Software, 26 Station St, Nunawading Vic. 3131. (03)878-9276.

PROM programming service

For those companies or individuals whose PROM programming requirements are not large enough to warrant a PROM programming unit, Alfatron in Melbourne now offer a suitable service.

Interested people should contact Jeff Romans for details on available PROM types and data formats to be used. Alfatron are located at 1761 Ferntree Gully Road, Ferntree Gully Vic. 3156. (03)758-9551.

Spillbinder Spelbinder Spellbinder!

If you have trouble managing your vowels and your consonants, then you'll undoubtedly be interested in the Spellbinder word processing and office management system.

A product of Lexisoft Inc of the US, it is distributed exclusively throughout Australasia by the Sydney-based company Software Source.

Lexisoft claim Spellbinder is a "full-feature word processing system with office management capabilities", and say that it is easy to use by office personnel and features flexible print formatting and output capabilities. Features may be added to suit the unique requirements of each user.

It will operate under CP/M or Oasis operating systems with 32K or more of memory. Software Source say Spellbinder will operate on the following micros: Apple, Cromemco, Heath, North Star, Sorcerer, Superbrain, TRS80, Vector Graphics and Zenith.

Spellbinder is available on either 8" S.D. or most 5¼" format disks. For a complete overview of Spellbinder's capabilities, contact Software Source, P.O. Box 364, Edgecliff NSW 2027. (02)33-4536.

New 3M distributor

Circuit Components (A'asia) Pty Ltd is now a fully franchised 3M distributor, and besides the well-known Scotchcal photosensitive label range and Scotchflex flat cable system, are offering the complete range of data recording products, including the popular sizes of diskettes in both single diskette envelopes or the bulk packs.

Included in the range are the unique head-cleaning diskettes, and a general purpose cleaning kit especially suited for maintenance of printers of the various types.

Also available are certified digital cassettes, personal computing cassettes, Black Watch computer tapes, cathode ray tube screen filters, electrostatic mats, etc.

Full details from Circuit Components (A'asia) Pty Ltd, P.O. Box 70, Bexley NSW 2207. (02)59-3720.

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Club Call

We've been informed of the formation of a new group up in Queensland — the **Brisbane FORTH Interest Group**. They've had several meetings so far, and members have versions of FORTH and STOIC running on CP/M, Sorcerer and 6809 systems. They would welcome anyone with similar interests to the group; contact Wally Brake on (07)38-4568 (ah) for more information.

Another new formation, this time in New South Wales — the **Macarthur Computer Users' Association** for Campbelltown and the surrounding area. The club is open to all people interested in computing, be it micro, mini or mainframe. Contact Mr. C. Wylie, 85 O'Sullivan Rd, Leumeah NSW 2560, (046)26-1625, for more information.

The **Northern and Western Suburbs Computer Users' Group** of Victoria tell us of a change of premises and committee. You can now contact them at CP/M Data Systems, 284 Union Rd, Moonee Ponds Vic. 3039, or by phoning Mr. Ken Patterson on (03)375-2144. Their new president is David Coupe, Secretary is John King, and Treasurer is Bill Roem.

The **Australian ZX80 Users' Association**, based in Canberra, puts out a pretty good newsletter for members, containing lots of news, programs, opinions, reviews and, as they put it, "anything else we can think of". In the issue we saw there was even an article telling you how to get white on black video. You can contact the group at their mailing address, 19 Godfrey St, Campbell ACT 2601.

The **TI-99/4 Users' Group** of Sydney also puts out a newsletter (called 'News Digest' and using the ETI News Digest logo — naughty, Shane!), and would welcome not only new members but also more contributions to their editorial output. At present the only membership charge is that you provide copies of your programs on cassette to be available to other members. For more information contact Shane Andersen, PO Box 101, Kings Cross NSW 2011, (02)358-6662 (ah).

An **Australian MicroAce Users' Group** is being formed for owners and users of this low-cost kit computer. The idea is to allow everyone using the MicroAce to pool their experience, software and resources for mutual benefit. Those interested in joining the group should contact Paul Willmott, 62 Alice St, Lakemba NSW 2195, (02)759-5500.

Compute, the microprocessor users' group newsletter of National Semiconductor (Australia) Pty Ltd, is back again after a longish absence from the scene. It brings news of new developments from Natsemi, and includes a data sheet request form — just fill it in and send it to 'Julie', and everything you desire will be yours. You can contact Compute at National Semiconductor, Cnr. Stud Rd and Mountain Highway, Bayswater Vic. 3153, (03)729-6333.

The **South Australian Microprocessor Group Inc** is running an interesting lecture series as part of its monthly meetings; according to their newsletter, the September 11 meeting will include a talk on speech synthesis by Richard Schipper. Meetings are held at Thebarton High School, Aspley St, Thebarton SA, and you can contact this well-established group at PO Box 113, Plympton SA 5038. (08)278-7288.

The **IREE Microcomputer Interest Group** of Queensland meets on the second Friday of each month in the Old Town Hall, cnr. Vulture St and Graham St, South Brisbane, at 7.30 pm. Visitors are always welcome, and the September meeting will include a lecture and demonstration covering the implementation of disks on the Apple system. The address for correspondence is c/- N. Wilson, Secretary PO Box 81, Albion Qld. 4010, (07)356-6176.

Micro User News is a newsletter produced by Adelaide club members who have a particular interest in Tandy-compatible hardware and software. Annual subscripton is $5, for which you get news, programs, reviews, etc. You can contact Micro User News at its postal address, 36 Sturt St, Adelaide SA 5000, or by phoning the Secretary, Rod Stevenson, on (08)337-6682 (ah) or 51-5241 (bh).

The **Apple Users' Club** of WA comprises 60-odd members and meets monthly at different venues. They produce a monthly newsletter and have a program library of ten BASIC and eight Pascal disks. Phone Secretary John Currie on (09)325-8700 for more information.

The **Spectrum Users' Group** in Victoria would like to hear from Spectrum-II users anywhere in Australia who would like to make use of the organisation's facilities. These include current information and news of developments from D.D. Webster Electronics Pty Ltd, designer and manufacturer of the Spectrum, lectures, seminars, a monthly newsletter, copies of papers delivered at meetings, plus all relevant Spectrum and DEC literature. Current membership is around 50, and costs $30 per year for a group or company and $15 for individual membership. Contact Mr. Spence Williams, Chairman, Spectrum Users' Group, Computer Science Dept, Box Hill Technical College, Dunloe Ave, Box Hill Vic. 3129, or Mr. Greg Cain, Treasurer, 7 Cockaigne St, Doncaster Vic. 3108.

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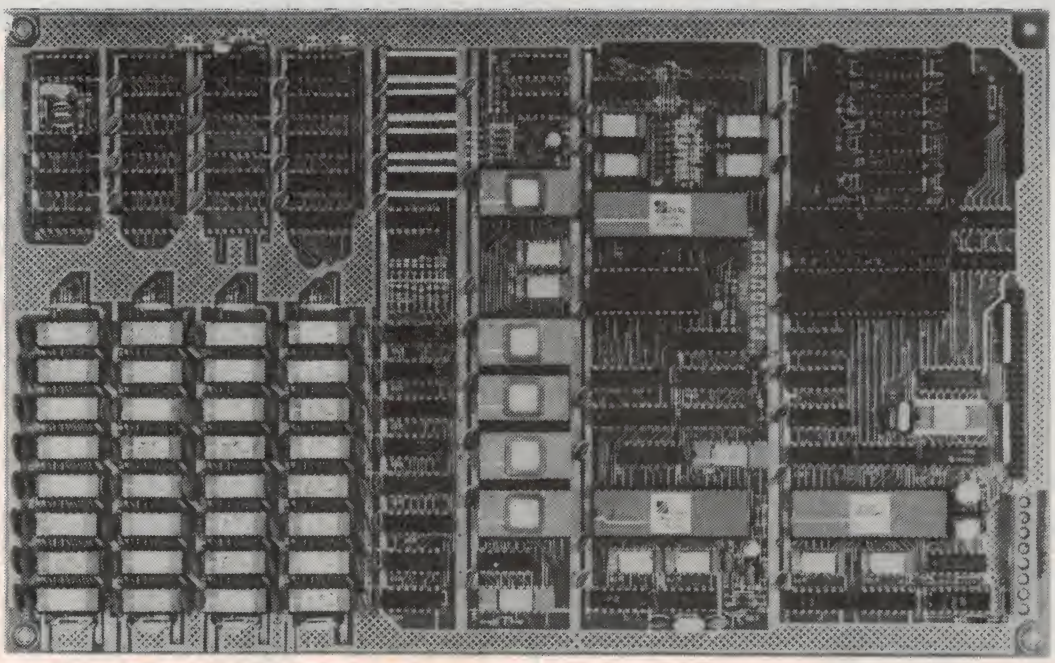

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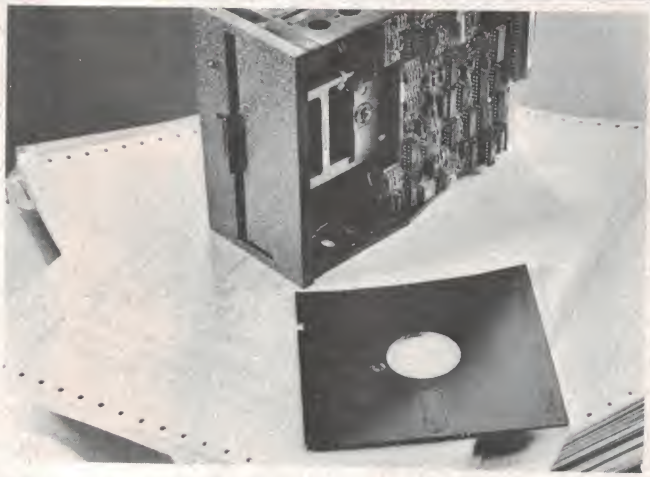


5¼" challenge to 8" disk

Speed and storage capacity limitations of the 5¼" floppy drive have been overcome by MPI, who claim their Hi-D (High Density) B92 Series can store up to 1 Megabyte on a double-sided disk and access at the rate of 5 ms track to track.

MPI have achieved these features through the use of a taut band positioner which is inherently stable and gives excellent repetition while minimising the number of moving parts.

To make the user feel more at home, MPI have incorporated a pushbutton disk eject. A head load solenoid to increase media and head life is standard.

MPI make a series of drives from 40, 77 and 80 tracks single and double-sided, all incorporating these innovations, yet maintaining total plug compatability with the industry standards.

Applications are said to be upgrades and add-ons for mini-computers including Apple and TRS-80, mass storage in process equipment and remote logging devices.

More information can be obtained from Daneva Australia Pty Ltd, 66 Bay Rd, Sandringham Vic. 3191. (03)598-5622.

For Sorcerer Apprentices

Those of you programming in Z80 Assembler may have been wondering from time to time why certain instructions exist. The instructions that are not clear in their usage are "CP A" and so on. Since the CP (compare) function always acts on the A register, it appears to be pointless to take such actions. So why are they used so often? The answer is quite simple.

If you want to clear the carry flag, you have a two-step Z80 function at your disposal: SCF (set carry flag to be sure it is set) and then CCF (complement carry flag). To achieve this we used two bytes. A simpler way is to OR A. This is a one-byte instruction, and it is one of a set of seemingly useless source statements:

```
Source statement:   Action:
OR A                ;clear carry flag
CP A                ;set zero flag
XOR A               ;clear A, carry flag; set zero flag
AND A               ;clear carry flag
SBC A,A             ;copy carry flag to minus flag
LD A,A              ;parity flag (P/V)
                    ;set to contents of IFF2
                    ;(IFF2 = interrupt flip/flop 2)
```

Speaking of machine language programs, if you have the need to ask for a number in decimal which has to be converted to hexadecimal, and if you keep the BASIC ROM pac in place at all times, you can use BASIC's input/conversion routine as follows:

```
CALL    0C53A   ;BASIC keyboard entry          (CD 3A C5)
CALL    0C7EA   ;convert number to DE          (CD EA C7)
RET             ;decimal number is now converted to
                ;hexadecimal and stored in the DE register
                ;CALL 0E1E8 to print result
```

or vice versa from hexadecimal to decimal:

```
CALL    0E13A   ;monitor keyboard entry        (CD 3A E1)
PUSH    IY      ;point
POP     HL      ;HL to beginning of number
CALL    0E23D   ;convert number into DE register
JP      0D7BC   ;jump to BASIC ROM conversion and printing
```

Note that both routines work with the Standard Exidy and the Software Source pac; other BASIC modifications may not accept the above programs.

While we're on the subject of BASIC, how often have your BASIC programs crashed or you've accidentally hit RESET or whatever? A program to resurrect a BASIC program is a very fine utility indeed. The following listing is about the shortest one around, and is brought to you compliments of Greg Lister of Software Source. It can be located anywhere in memory; I suggest you load it somewhere in the user graphics (FE00 hex onwards)

```
XX00:  3E 0D 32 D6 01 21 D4 01 06 03 7E 23 B7 20 F9 CD
XX10:  A2 E1 ED7B 45 01 C3 8E DC
```

When you have a crash, go into monitor and then ›GO XX00 or wherever you entered the program. You will then be returned to BASIC command level automatically. When you list the program and find that the first few lines look funny, you can blame Exidy BASIC for it. When you hit RESET, BASIC will write some garbage in that area. To avoid any disappointment, always make your first few lines REM ****.. statements. Three whole lines (at 64 characters) should do the trick.

Then, when you do have a RESET crash, you will be able to remove the garbage without destroying the integrity of your program.

One of the Sorcerer's drawbacks is its keyboard entry. That is, if you call the normal keyboard entry routine at E018 the execution of your program will be stopped until you release the key that you have pressed, unless it is a rollover key like the Control, Graphic or Shift keys. When writing games programs it is often desirable to be able to simply scan the keyboard without it locking up. The following routine does just that. It checks for the SPACE BAR. As soon as the space bar is pressed, control is passed back to the program. Pressing any other key will be without effect. Also, keeping the space bar pressed down will have no effect.

```
100  RESTORE 200 : REM point to data in case other data
150  FOR X = 0 TO 10 : REM in program
160  READ A : REM read and store the 11 values from 0 to 11 (0 to
     B hex)
170  POKE X,A : REM
180  NEXT : REM and initialise the USR function
190  POKE 260,0 : POKE 261, 0
200  DATA 62, 1, 211, 254, 219, 254, 203, 87, 32, 246, 201
210  PRINT" program now initialised
220  PRINT "for a demonstration, ";: GOSUB 1000
230  PRINT "note that other keys have no effect
260  END
1000 PRINT "press ‹SPACE BAR› to continue":
     X=USR(0): RETURN
```

Product reviews:

This month I'll review three programs, all of them technical programs designed to make the programmer's life a bit easier. All three programs were submitted by Software Source, P.O. Box 364, Edgecliff NSW 2027.

STRING: This program allows you to save numeric and string arrays on tape and retrieve that data individually. It is a machine language program residing in the user graphics area. This means that you won't lose any BASIC memory, i.e: you'll have the same amount of free bytes whether the program is resident or not. The files saved on tape are named according to the data fields saved, so you can see what data you have where with the FI command. Documentation is excellent, and a sample program is provided on the reverse side of the cassette. Recording quality is good; no CRC errors were encountered over a wide range of volume adjustments. It works under Standard Exidy BASIC as well as Software Source's Mod 1.01. BASIC. String is easy to use and provides an easy and reliable answer to the problems of saving Exidy data on cassette.

The Sorcerer's graphic capabilities are certainly a good asset, but it is a cumbersome task to define the graphic characters. Not so if you use GRAFIX. This program allows you to define the graphic characters with ease and speed. It is written entirely in machine language, and up to 24 characters may be defined at the same time. Inverse, tilting, flipping, in fact anything I could think of, can be done with the graphic characters. Grafix continually displays the whole set of graphic characters, so you can always see what you've defined already. The program automatically saves to tape, and allows you to list the codes in hexadecimal and decimal to printer or screen. It even checks if a printer is connected to your Sorcerer and warns if not. It also allows you to print three lines of eight characters for headings or covers, which is an unexpected fringe benefit. An extensive user's guide is supplied with Grafix, and again recording quality is good. Anyone writing programs requiring special graphics definition should have Grafix.

REFORMAT, the last of this month's programs, is simply a must. It is a CP/M disk program. Those of you lucky enough to have disks will come across bad sectors on them sooner or later. I've had four of these disks and thanks to Reformat, they are all OK again. You simply put the damaged disk into your drive; Reformat will go through every track and sector and reformat it. If a sector was OK, it won't damage any data; if the sector was damaged, Reformat will give you the track and sector number, fix it and go on to the next. This even works on the directory track. Reformat rescued every one of my damaged disks. It is an essential program for any CP/M user.

To get a review of your program in this column simply send it to ETI c/o A.P.F. Fry. Any programs submitted will be returned to you upon request. Please supply user instructions or documentation as supplied to purchasers.

And here's a letter to editor:

Dear Sir,

I have a friend with an Exidy Sorcerer and have worked out three ways of determining PI.

The first way [Monte Carlo Method] is not very good. The second way [Squares Method] is better but takes several hours to reach a reasonable value. The third way [Calculus Method] is very good. I enclose a copy of the program (based on Micropolis BASIC):

```
110  REM CALCULUS METHOD TO DETERMINE P1 by J.Kitchen
     VK6TU
130  PRINT CHR$ (12)
140  SIZES (10,8,80)
150  P = 0 : H = 1
160  A = 1 : X = 1 / SQR (3) : Y = 0
170  PRINT "TO WORK OUT VALUE OF 'PI' "
175  PRINT
180  "ENTER ANY EVEN VALUE FOR NO OF TERMS "; T
186  IF T › 34 THEN PRINT "NO OF TERMS TOO HIGH (34 MAX)
     REENTER ": GOTO 180
190  IF T/2 ‹› INT (T/2) THEN PRINT "TRY AN EVEN NUMBER ":
     GOTO 180
200  PRINT
220  Y = (X^A)/A
230  IF H/2 = INT (H/2) THEN 250
240  P = P + Y : GOTO 260
250  P = P – Y
260  IF H = T THEN 285
280  GOTO 220
285  PRINT "INDICES"; TAB(14) "NO TERMS"; TAB(36) "VALUE
     OF PI"
290  PRINT : PRINT A,H,P*6
295  H = H + 1 : A = A + 2
300  PRINT : PRINT : GOTO 180
32767  END
```

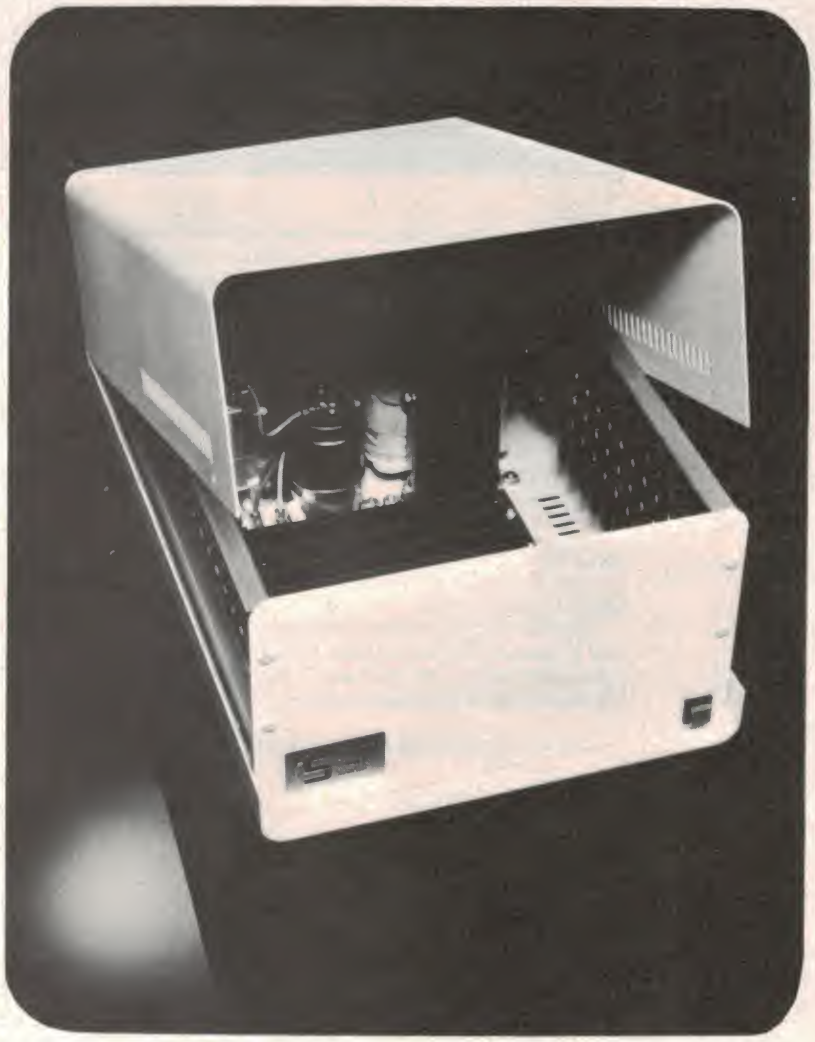
Note: this idea was derived from Holben's 'Mathematics for the Million'.

John Kitchen
VK6TU

Thanks, John. By now you'd be aware that a considerable delay has occurred due to my absence for several months; please accept my apology for this.

The MDOS and Micropolis BASIC users will be quite familiar with the statements above. However, the program will not function on Exidy's BASIC or Microsoft's BASIC80. The statement 'SIZES' allocates the number of digits for double precision calculating. Exidy does not support double precision and BASIC80 is limited to 16-digit precision. It is therefore unlikely that this program will provide a more precise number for PI in applications other than in Micropolis BASIC programs.

Bye for now,
A.P.F. Fry



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Alphasort — a program to sort alphabetical information

Arrange your printout with this program and never lose track of that lady's phone number again!

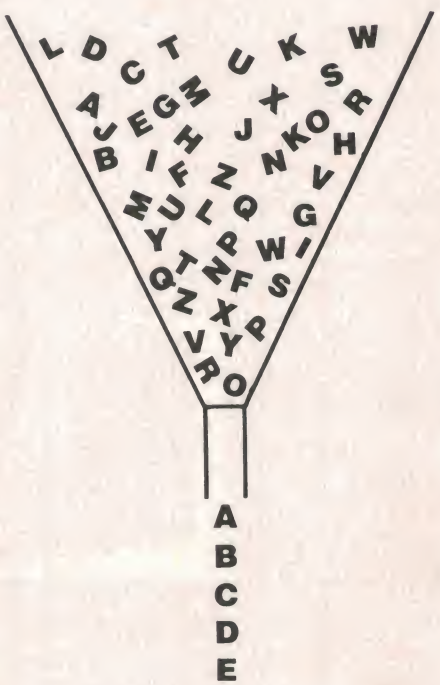
R.A. Jones

THE FOLLOWING piece of software has been designed to fill a number of needs. Although it is a 'stand-alone' program it can be easily adapted to act as a subroutine to fit into other programs, or even turned into a standard utility package. The sole function of the program is to sort lists of names, or indeed any alphabetical information, into order.

Program function

The software relies on the string handling facilities present in most versions of BASIC and without these cannot function as written. Indeed, if these functions are not present any sort program will run so slowly that the user will probably expire from boredom! The ability of these versions of BASIC to use mathematical operators such as $>, <, =$ and $\neq (<>)$ on string functions makes life very easy for the programmer.

The system of sorting is known as a 'bubble' sort (for no better reason than the similarity between bubbles rising through a liquid and the bigger entries rising through the list). It sets no records for speed but it does work and is simple to understand, a feature often worth far more. The two main segments are illustrated in Figure 1 and Figure 2. These are the input routine and the bubble sort routine and are further described later. The full program listing is divided up with REM statements; each of these segments represents a complete entity and can be amended or altered as desired. Some suggestions are given later in this article.



How it works

As previously mentioned, the application of mathematical operators is crucial to the bubble sort. The BASIC allows us to simply compare two string variables and make a decision as to whether one is bigger than the other, or whether they are equal in size. These comparisons are not confined to the first letter but work their way through the entire length of the string; for example:

Given two strings, A$ and B$, we can say that if A$ = "A" and B$ = "B", then A$<B$ is true. Similarily we can compare the string "JONES B G" with the string "JONES B H" and find that the first is 'smaller' than the second.

Given this facility we can sort any stored list of strings into order, either ascending or descending, although the latter is more common (lists of names usually go from A to Z). This segment is illustrated in Figure 1 and is the section of the program tagged BUBBLE SORT.

The first statement simply sets up two variables, one counter and one marker. The variable S is a 'swap' marker and tells us that a change has taken place in the list, the counter T is one less than the number of entries because you can't compare the bottom entry with anything! You now start a loop going for this many counts.

For each entry in the list (array A$(n)) you compare the absolute value with the entry directly below it in the list; if the first is bigger you swap them over and set the swap marker, if not you try the next pair. The changing over is done by the laborious method of putting the larger string into a spare variable, replacing it in the list with the smaller and then putting the larger one back. Anyone using a disk-based BASIC with extra functions can use the marvellous SWAP command and do the whole thing in one go. Having gone through the list once, the whole process is repeated until no swaps are recorded; the sorting process is now complete.

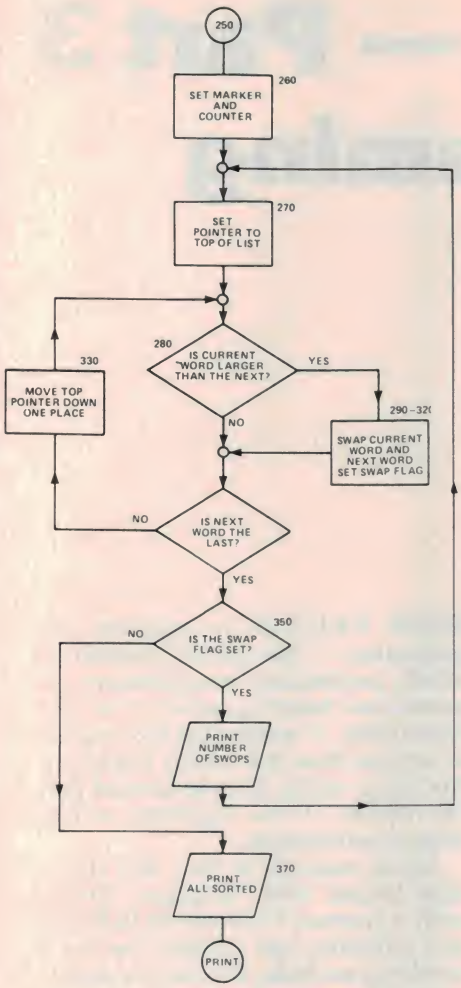


Figure 1. **The routine for bubble sorting strings**

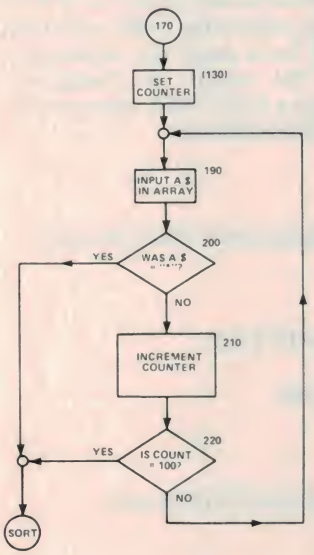


Figure 2. **The input segment in greater detail**

The input stage is also worthy of closer investigation. The maximum number of list entries is set up as 100 but this is really dependent on the amount of memory you have available. As each entry is input from the keyboard it is stored in an array at a position corresponding to its entry point. It is worth noting that the array starts at 0, a location which is often ignored or even forgotten. Entries continue until "*" is found, which terminates the routine. We now have an array full of raw data and a counter which tells us how many entries there are in the array. We may now sort it.

Getting listed

Actually producing the final list is dead easy; you simply output the array element by element. However, if your list is longer than your screen has lines, you may like to implement a loop which outputs a set number of entries at a time. A routine is given in the program called LINE LOOP, which does just this. The required number of lines is input to the program and then the routine waits for any key to be hit before outputting the first batch.

Enhancements

Some obvious goodies that can be built in are: reading data from a file, outputting to another file, outputting to a printer and doubtless others of a more specialised nature. Taking the first and second items, it should not prove too difficult to open a file and read entries both from it and back to it instead of keying them in by hand. Commands such as OPEN, INPUT# and PRINT# should be recognisable to most systems running a reasonable BASIC.

Printing out lists is also a matter of calling the printer rather than the VDU; if your system supports LPRINT then life is simple indeed! All you really need to do is to call a response from the keyboard to direct the output to the required device; it is worth making life idiot-proof by having the VDU as the default option. Owners of systems such as the PET who are using interfaces to connect to printers will have to treat the output like a file, but you must remember to CLOSE it after output is complete or else all your screen prompts tend to end up in the middle of your listing.

Other possibilities for the program are multiple lists. These offer no serious difficulty; you merely choose which list you are going to sort on and then, as you swap on the chosen list, swap the others as well. It is in situations such as this that the time taken starts to mount up. If we take a sample list such as fred, john, ian, bert, harry, the following swaps take place:

fred,john,ian,bert,harry
fred,ian,john,bert,harry
fred,ian,bert,john,harry
fred,bert,ian,john,harry
bert,fred,ian,john,harry
bert,fred,ian,harry,john
bert,fred,harry,ian,john

Now, if we had a parallel list of, say, their ages, the swap time would have been almost doubled. The maximum number of swaps that can take place is the factorial of the number of items in the list, the actual time taken being rather machine-dependent for obvious reasons. This time will also increase in direct proportion to the number of 'columns' that you have. As mentioned earlier, the program makes no apologies for its lack of speed. It is, however, as near universal as possible. ●

```
100 REM**ALPHASORT 2
110 REM**INITIALISATION
120 PRINT"[CLS]":CLR
130 DIM A$(100):EN = 100:CT = 0
140 PRINT "PLEASE INPUT NAMES, WHEN YOU
    ARE"
150 PRINT "READY TO SORT TYPE '*' "
160 PRINT
170 REM**INPUT ROUTINE
180 PRINT "YOU HAVE ROOM FOR ";EN;" MORE
    ENTRIES."
190 INPUT A$(CT)
200 IF A$(CT) = "*" THEN 250
210 CT = CT + 1:PRINT"[CLS]"
220 IF CT > 99 THEN 250
230 EN = 100-CT:GOTO 180
240 END
250 REM**BUBBLE SORT
260 S = 0:T = CT-1
270 FOR L = 0 TO T
280 IF A$(L) < = A$(L + 1) THEN 330
290 S$ = A$(L)
300 A$(L) = A$(L + 1)
310 A$(L + 1) = S$
320 S = S + 1
330 NEXT L
340 PRINT "[CLS]",S," SWAPS OCCCURRED"
350 IF S > = 1 THEN 260
360 PRINT
370 PRINT "ALL SORTED !"
380 REM**SIMPLE OUTPUT ROUTINE
390 PRINT
400 PRINT "HIT ANY KEY TO LIST"
410 GET R$:IF R$ = "" THEN 410
420 PRINT "[CLS]"
430 FOR LP = 0 TO CT
440 PRINT A$(LP)
450 NEXT LP
460 END
470 REM**LINE LOOP OUTPUT
480 PRINT
490 PRINT "HOW MANY LINES ON YOUR VDU";
500 INPUT SL
510 SL = SL-1:LP = 0
520 FOR P = LP TO LP + SL
530 PRINT A$(P)
540 NEXT P
550 PRINT "HIT ANY KEY TO CONTINUE"
560 PRINT " '$' WILL BREAK "
570 GET K$:IF K$ = "" THEN 570
580 IF K$ = "$" THEN END
590 IF CT-LP < SL THEN 520
600 SL = CT-LP
610 GOTO 520
620 END
```

The complete program listing; see the text for suggested enhancements.

Advanced BASIC — Part 3
Top-down programming

Phil Cohen

Following the series on Back Door into BASIC, ETI has begun a series on Advanced BASIC for those who want to follow up their elementary knowledge. Previous articles have explained 'Sorting' and 'Chaining'; this month Phil Cohen goes into 'Top-down programming'.

WHAT EXACTLY is 'top-down programming' — the almost mystical art which professional programmers are sometimes heard to refer to in awe? Essentially, it means that the program is written from the outside inwards — the main outline is programmed first, the details of the algorithm coming later in subroutines.

As an example of this, let's take a hypothetical chess program. Writing such a program from scratch in BASIC is a daunting task without the use of top-down methods. You have to start by knowing exactly what the program is required to do, and this takes a large amount of work on the definition of the task before programming can even begin.

With top-downing, the program is written *as you plan the task*. For instance, the main program may consist of only subroutine calls (i.e: GOSUBs), with the subroutine tasks only roughly defined. Let's make the explanation of this a bit easier by changing the language a little. We'll represent this:

```
10    GOSUB 1000
.
.
.
1000 REM ROUTINE TO ADD
.
.
.
1100 RETURN
```

by this:

```
10    add
.
.
.
1000 PROCEDURE add
.
.
.
1100 END
```

This nomenclature will be familiar to those who have met ALGOL or PASCAL — languages ideally suited to top-downing. The word 'add' (unless preceded by the reserved word 'PROCEDURE') means that control is to be passed to the line of the program at which 'PROCEDURE add' occurs. This is entirely analogous to 'GOSUB', except that a name is used instead of a number to define the subroutine's start. The word 'END' has the same effect as 'RETURN' in BASIC.

Let's start writing our chess program. The main program may consist of:

```
10 set-up-board
20 input-human's-move
30 check-human-move-legal
40 make-move
50 test-for-human-win
60 choose-best-move
70 make-move
80 test-for-machine-win
90 GOTO 20
```

Then the subroutines can be worked out in detail:

```
4000  PROCEDURE set-up-board
4010  change-memory
4020  print-results
4030  END

11000 PROCEDURE print-results
11010 FOR I=1 TO 8
11020 FOR J=1 TO 8
11030 print-square(I, J)
11040 NEXT J
11050 PRINT
11060 NEXT I
11070 END
```

In line 11030 we see parameter passing. This is also found in BASIC:

```
10 A = SIN (B)
```

the only differences being a) that here there is more than one parameter and b) that the procedure 'print-square(,)' delivers no result to the calling program. In this sense it is similar to the TAB() function in BASIC.

It can be seen from the above segment that this sort of top-down approach is easy in an ALGOL-like language — but how can we make use of it in BASIC?

Let's try re-writing the above example in BASIC:

```
10 GOSUB 1000 : REM SET UP
     BOARD
20 GOSUB 2000 : REM INPUT
     HUMAN'S MOVE
30 GOSUB . . .
```

and so on. Now for the subroutines:

```
4000 REM MAKE MOVE
4010 GOSUB 1000 : REM CHANGE
       MEMORY
4020 GOSUB 11000 : REM PRINT
       RESULTS
4030 RETURN

11000 REM PRINT RESULTS
11010 FOR I=1 TO 8
11020 FOR J=1 TO 8
```

Now here we hit a small problem. In BASIC there is no statement which will allow parameter passing to a subroutine, such as

```
11030 GOSUB(I, J) 12000 : REM
        PRINT SQUARE
```

and so we have to resort to

```
11030 GOSUB 12000 : REM PRINT
        SQUARE
11040 NEXT J
11050 PRINT
11060 NEXT I
11070 RETURN

12000 REM PRINT SQUARE
12010 P = B(I, J)
.
.
.
```

where P is the number representing the piece to be printed and B(,) is an 8 x 8 array which holds the current state of the board. Variables I and J are called 'global' variables in this context, because they have the same meaning inside and outside the subroutine.

Zoning

There's only one thing wrong with the above method in BASIC and that is that variables used in other routines (or in the main program) shouldn't change value in routine 'print-square'. This is all very well if you can keep track of *all* the variables you use in a large program. This is not always easy, however, and mistakes can take a very long time to find. Another point is that 'library' routines — useful ones which are going to be used in more than one program — will have to use non-overlapping sets of variables.

Languages such as ALGOL take care of these problems automatically — variables are defined on entry into a subroutine and will be destroyed on exit. Those which were used in the calling routine and re-defined on entry to the called routine will have their value stored on entry and will be set to their original value on exit.

Unfortunately, routines written in BASIC have to have this storage and retrieval added to them as they are written. One way to do this is to define a general-purpose stack:

```
10 DIM  S(100)  :  REM  (NO
     RELATION!)
20 SP = 0
30 SE = 100
```

and, on entry to each routine, to push onto the stack the values of the variables (except those which are parameters) which are used in the routine. These can then be pulled off the stack on exit:

```
12000 REM PRINT SQUARE
12010 IF SP = SE THEN PRINT
        "STACK      OVERFLOW":
        STOP
12020 SP = SP + 1
12030 S(SP) = P
12040 P = B(I, J)
.
.
.
12100 P = S(SP)
12110 SP=SP - 1
12120 RETURN
```

Lines 12010 to 12030 and 12100 to 12110 will be repeated (with a different variable each time) in *all* routines, and so we can shorten the above in the long term:

```
10 DIM S(100)
20 SP = 0
30 SE = 100
35 GOTO  500  :  REM  MAIN
     PROGRAM
40 REM PUSH
50 IF SP = SE THEN PRINT
     "STACK OVERFLOW":STOP
60 SP = SP + 1
70 S(SP) = XX
80 RETURN
90 REM PULL
100 XX = S(SP)
110 SP = SP - 1
120 RETURN

12000 REM PRINT SQUARE
12010 XX = P : GOSUB 40 : REM
        PUSH
11020 P = B(I, J)
.
.
.
12100 GOSUB 90 : REM PULL
12110 P = XX
12120 RETURN
```

XX is a parameter to the push and pull routines and obviously shouldn't be used anywhere else.

Example

As an example of zoning, the following 'library' routine will print out the value of variable A in a format N characters wide. For example:

```
A = 1, N = 3 : 1.0
A = -0.01, N = 5 : -1E-2
A = 155, N = 4 : 2.E2
```

First, the stacks:

```
10 DIM S(100), S$(20)
```

two of them — one for numeric variables and one for strings. Also, two stack pointers:

```
20 SP = 0 : P2 = 0
```

and two end-of-stack indicators:

```
30 SE = 100 : E2 = 0
```

Jump to the main program:

```
35 GOTO 500
```

Now for the stack handling routines. The first two are as before, for the numeric variables:

```
40 REM PUSH
50 IF SP = SE THEN PRINT
     "STACK OVERFLOW":STOP
60 SP = SP + 1
70 S(SP) = XX
```

▶

```
80 RETURN
90 REM PULL
100 XX = S(SP)
110 SP = SP - 1
120 RETURN
```

then the strings:

```
130 REM PUSH STRING
140 IF P2 = E2 THEN PRINT
    "STRING OVERFLOW":STOP
150 P2 = P2 + 1
160 S$(P2) = X$
170 RETURN
180 REM PULL STRING
190 X$ = S$ (P2)
200 P2 = P2 - 1
210 RETURN
```

Now for the main program. This one is just a test routine:

```
500 INPUT A
510 INPUT N
520 GOSUB 1000
530 STOP
```

Finally, the formatting routine itself. It begins by pushing all of the original values of the non-local variables onto the stacks:

```
1000 REM FORMAT
1010 XX = SA : GOSUB 40
1012 XX = SN : GOSUB 40
1014 XX = E : GOSUB 40
1016 XX = LL : GOSUB 40
1018 XX = L : GOSUB 40
1020 XX = K : GOSUB 40
1022 XX = I : GOSUB 40
1024 X$ = A$ : GOSUB 130
1026 X$ = B$ : GOSUB 130
```

SA and SN are stores for the input values of A and N. This is necessary because of the iterative nature of the routine, as will be explained later:

```
1060 SA = A
1070 SN = N
```

E is the 'rounding' figure. This is also part of the iterative procedure:

```
1080 E = 38
```

LL is a constant which is used to convert natural logs (as found in BASIC) to base 10 logs:

```
1090  LL = LOG(10)
```

Line 1097 is the start of a loop in the program, so A and N are re-initialised here:

```
1097 A = SA
1098 N = SN
```

as are A$ and B$ — A$ holds the mantissa of the output while B$ holds the exponent:

```
1099 A$ = "" : B$ = ""
```

Both are set to the null string. Check to see if A is zero. This would upset the algorithm and so it is 'trapped' here:

```
1110 IF A = 0 THEN A$ = "0" :
     GOTO 2040
```

Line 2040 is the exit from the routine. Now see if a "–" sign is required:

```
1120 IF A > 0 THEN 1160
1130 A$ = "–" : A = ABS(A)
1140 N = N - 1
1150 IF N = 0 THEN 2040
```

and if it is, add it — as we have to deal from here on in with a positive number, we can 'forget' whether A was negative or not, as long as we've added a "–" sign if it was required. N is decremented if the "–" character *was* added and if there's no more room (i.e: if N = 0) we're finished — 2040 is the exit.

Now for the rounding up (explanation later):

```
1160 A = A + 5/10↑E
```

Now to find the exponent part of the output:

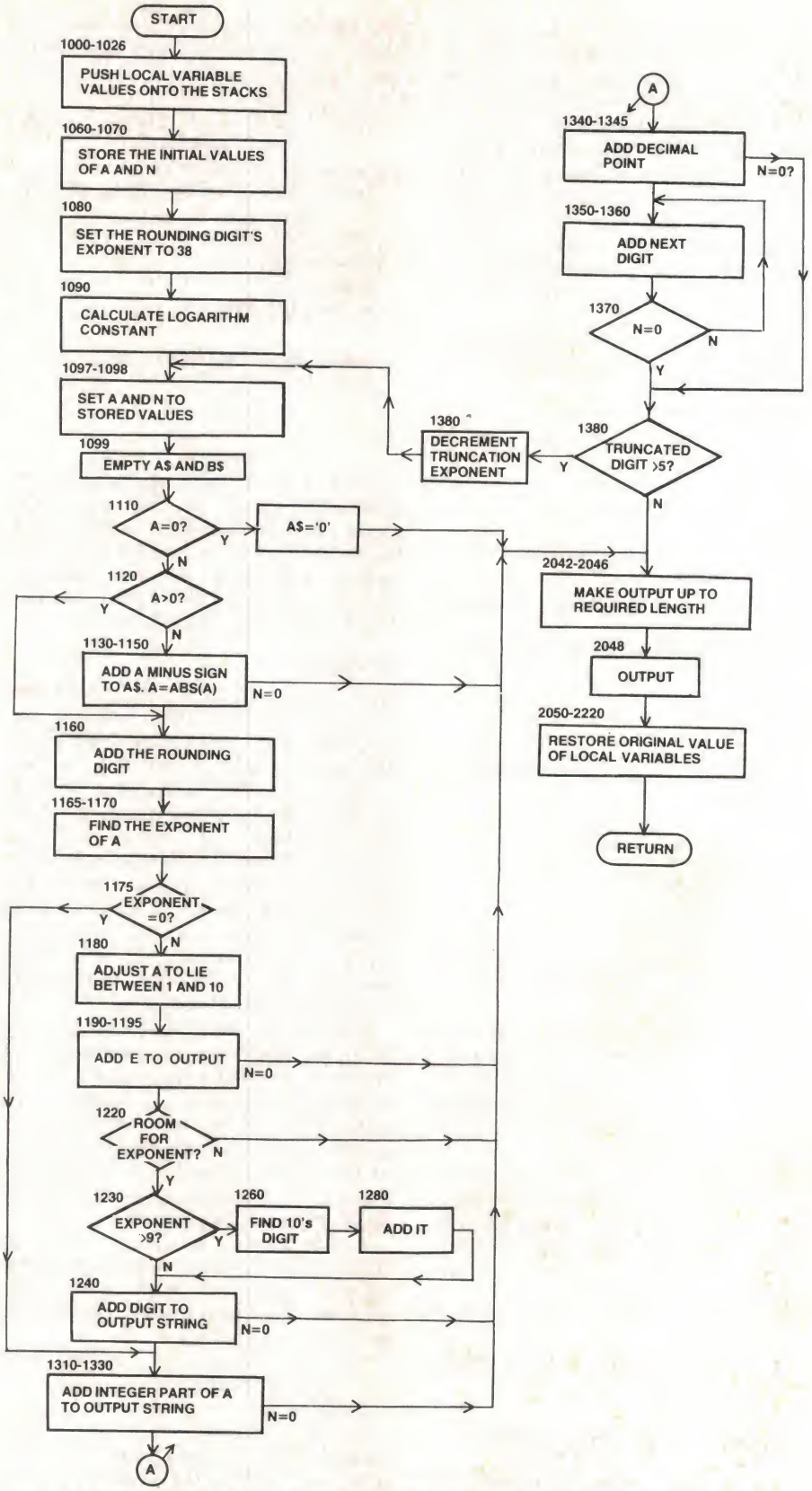


Figure 1. **A full flowchart for a routine to display the value of variable A in a print field of width N.**

```
1165 L = LOG(A)/LL
```
sets L to the base 10 log of A.
```
1170 L = INT(L)
```
makes L the required exponent.
```
1175 IF L = 0 THEN 1310
```
misses out the exponent output section entirely if an exponent is not required. 'Forget' the exponent part of A — we have it already in L:
```
1180 A = A/10↑L
```
Start putting the exponent into B$:
```
1190 B$ = "E" : N = N - 1
1195 IF N = 0 THEN 2040
```
Find out whether a "–" sign is needed in the exponent and add it if it is:
```
1200 IF L > = 0 THEN 1220
1210 B$ = B$ + "–" : N = N - 1 : L =
     ABS(L)
```
Check to see if there's room for the exponent (if it's two figures, having room for only one could be misleading):
```
1220 IF N = 0 OR (L > 9 AND N < 2)
     THEN 2040
1230 IF L > 9 THEN 1260
```
jumps if two figures are needed. If only one is required, add it:
```
1240 B$ = B$ + CHR$ (ASC("0") +
     L) : N = - 1
```
The above statement is based on two functions — ASC(), which delivers the ASCII value of a character, and CHR$(), which delivers the character equivalent of an ASCII value. As the ASCII numbers are in sequence, starting from 0, the above statement will add the character corresponding to the value of L. Now jump the next bit, which is only required for two-digit exponents:
```
1250 GOTO 1300
```
Find the first (most significant) digit:
```
1260 K = INT(L/10)
```
and the least significant:
```
1270 L = L - K*10
```
Add the first character:
```
1280 B$ = B$ + CHR$(ASC("0") +
     K) : N = N - 1
```
then jump back to add the next as if it were a one-digit exponent:
```
1290 GOTO 1240
```
After adding the exponent, start on the mantissa (A should be between 1 and 10 by now):
```
1300 IF N = 0 THEN 2040
1310 K = INT(A) : A = A - K : A =
     A*10
```
strips the most significant digit from A and puts it between 0 and 10.
```
1320 A$ = A$ + CHR$(ASC("0") +
     K) : N = N - 1
1330 IF N = 0 THEN 2040
```
Now add the decimal point:
```
1340 A$ = A$ + "." : N = N - 1
1345 IF N = 0 THEN 2040
```
Add the subsequent digits:
```
1350 K = INT(A) : A = A - K : A =
     A*10
1360 A$ = A$ + CHR$(ASC("0") +
     K) : N = N - 1
1370 IF N > 0 THEN 1350
```
Once it's got through that, N must be zero and A must be the value of the next figure — the one which is 'truncated' (Lit. 'cut off'). Let's say that A on entry to the routine was 1.46 and that all we had room for was 1.4. It would be nice to display 1.5 instead, which would be closer to the truth. So if A at this stage is greater than 5, it means that the number needs 'rounding up'. We can't just change the last digit of the output — say it was 9.999 and we only had 4 spaces for it (one for the decimal point, remember); if we put 4 digits in we get 9.99 — we find that the truncated part is a 9 and so we change the last digit — we get 9.90. This is obviously not correct. Even if we change *all* the digits, we get 10.00 — this is now 5 characters long!

No, by far the simplest (although certainly not the quickest) approach is to start again. How do we deal with the rounding up, though? We add a 5 in the truncated position. In this way, if the number in this position is 5 or over, it will overflow into the higher digits. Wait a minute, though, we don't know which will be the truncated digit until we try it. What we have to do is to start with it at the extreme right-hand end of the number (i.e: at 5E–38 – the smallest number in many BASICs) and, *if the truncated digit is over 5*, to move it up until it makes the truncated part overflow. This is what lines 1080 and 1160 are for. Find out if iteration is required:
```
1380 IF A > = 5 THEN E = E - 1 :
     GOTO 1097
```
Now print the result.
```
2040 A$ = A$ + B$
```
Make up the length to that required:
```
2042 IF LEN(A$) = SN THEN 2048
2046 FOR I = 1 TO SN - LN(A$) :
     A$ = A$ + " "
2047 NEXT I
2048 PRINT A$;
```
Now set all the local variables back to their original values *in the reverse order:*
```
2050 GOSUB 180
2060 B$ = X$
2070 GOSUB 180
2080 A$ = X$
2090 GOSUB 90
2100 I = XX
2110 GOSUB 90
2120 K = XX
2140 GOSUB 90
2150 L = XX
2160 GOSUB 90
2170 LL = XX
2180 GOSUB 90
2190 E = XX
2200 GOSUB 90
2210 SN = XX
2220 GOSUB 90
2230 SA = XX
2240 RETURN
```
And that's it! ●

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PET talk — BASIC optimisation

This article is devoted to saving both memory and execution time of BASIC programs running on the Commodore PET. Many of the tips are applicable to other micros and languages.

D. Bolton

OPTIMISATION can be achieved in several areas: program control flow, data storage, numerical methods and strings.

Program control flow

All BASIC programs execute statements one after another until a break in the flow is made and a branch occurs. On most interpreter BASICs, GOTOs and GOSUBs take place by searching the program for the designated line number. The search naturally begins at the start of the program and therefore takes longer in larger programs. Two methods suggest themselves for speeding up programs. First, make the program shorter and, secondly, reduce the number of branches. A good idea for achieving the latter is to break the program into a number of blocks (*not subroutines*), each having only one entrance and only one exit.

Subroutines which are called very frequently will contribute a noticeable time-saving if they are put near the start of the program. This might go against the 'standards' of 'respectable' programming, but it is definitely faster. Something on the lines of

```
1 GOTO 25
2 (Fast subroutines)
24 (End of fast subroutines)
25 (Rest of main program)
```

The following ideas will each reduce the size of a program by a few bytes and together can make a significant space and time saving.

Squashing it up

Always use variables instead of constants. For example, set P = 3.141596 (for those BASICs without PI). Every reference to P saves seven bytes and it is faster to fetch the value from a variable than to have to read it as a constant.

Remove all superfluous spaces and REM statements. With spaces between '=' and variables, etc, a program takes measurably longer. Please note, however, that editors like spaces so they can actually read your submitted programs.

Each line in a program has an overhead of five bytes (two for the line number, two for the link address and one for the end of line), so compressing the statements and thus removing lines is good for speed, though it can make a program unreadable to others. 427 lines of totally compressed program takes up 15K on the PET.

Microsoft BASICs allow NEXT statements without specifying the variable. This will save a byte or two, but can be awkward under certain circumstances, such as a jump out of a FOR-NEXT loop. Because no check is made upon the variable the last unfinished loop will be

completed. This space-saver is perhaps best left until a program is nearly completed. The other advantage of NEXT statements without variables is that they are faster.

Those with the 'TOOLKIT' or some other renumbering device can make improvements upon a finished program by renumbering in steps of one starting at line 1. This is because the line numbers in GOTO (etc.) statements are held in character form. For example, 2000 takes up four characters, while 200 takes three. Typical saving for a 15K program thus renumbered is an amazing 500 bytes.

While talking about the TOOLKIT, its presence when 'switched on' affects the speed of the PET, slowing it down to five-sixths speed. When development is finished don't use it. Any 6502 routines which 'poach' input in a similar fashion will also have a detrimental effect on speed.

Finally, in this section, do any of your subroutines finish off with a call to another subroutine?

```
100 GOSUB 2000: RETURN
```

These can all be altered to 100 GOTO 2000. Obvious to some, perhaps not to everyone.

Data storage

This section is concerned with efficient use of storage rather than execution time, though one *can* follow from the other.

Integers are only better when large arrays are used. A single variable occupies seven bytes, though only two hold its value. Real numbers with whole values will process just as fast and in some cases quicker than integers. This is because A is physically shorter than A%. Non-string arrays occur in the memory map directly after the simple variables and, if a new variable occurs, then all of these arrays have to be moved down seven bytes in the memory.

In the table of simple variables, their presence or lack of it is detected every time a variable is referred to in the program. For quickest execution, those frequently used variables should be defined as early as possible in the program, perhaps without dummy values.

Integer arrays can hold numbers outside the range −32768 to 32767, providing two conditions are met. These are that the numbers are all whole numbers and that their range (highest-lowest) is under 65536.

For example consider 427654, 442501, 451002 and 488814. A compensating factor (CF) is found by adding 32768 to the first item. CF is then subtracted from all of the list items to give their integer values.

Obviously this method has its limitations, but it has been used successfully in a sales ledger, where up to a thousand invoice numbers have to be in RAM at the same time. The savings are very worthwhile.

By lowering the amount of memory that the PET thinks it has, one can produce a safe section of RAM which will not be touched by the program. Single byte numbers (range 0-255) can be POKEd and PEEKed into this area, allowing up to one 30 000 element array. Lowering allocated memory space can be achieved by calculating the new 'top of memory' address and converting this into two values which are POKEd into locations 52 and 53 (new ROMs) or 134 and 135 (old 8K ROMs).

String

This final section has been separated from data storage because strings (on the PET anyway) have some eccentricities.

Before we go on I have to define what is meant by 'free' memory. This is the area which is not used to hold any data and lies above the numeric arrays and below the strings in the memory map. When a FRE(0) is performed, this indicates how many bytes of 'free' memory are left.

Free memory is used to contain strings when an output or concatenation takes place. The PET stores strings in two places. One part contains the variable name, length and pointers to string memory where the string itself lives. String memory expands down into free memory as various operations are done, but in an assignment, say B$ = B$+C$, the old value of B$ is *not* destroyed. This is because in a statement like A$ = B$, the pointers in A$ are set to those in B$ and both share the same string. To be able to destroy an old string would involve a search of all strings to find if they were 'sharing'. A search for every assignment would be terribly slow. When 'free' memory is full then a 'Garbage Collection' takes place and moves all the allocated strings to the top of memory, thus making free space available again.

The trouble is that a Garbage Collection can take a great deal of time. It really depends on the number of strings in use at the same time. Worst cases can be over 20 minutes in which the PET just sits there!

If you use a lot of strings then you are going to have to accept the inevitable. Nothing can be done about the time needed for a Garbage Collection, but a bit of forethought can reduce the frequency of their occurrence.

A fairly common example will illustrate the problem; build up a string of 100 spaces for later use:

```
10 A$ = " ":FOR I = 1 TO 1000:A$ =
   A$ + " ":NEXT
```

That simple little operation takes a fraction of a second and uses up 5K of free memory! The sum of 1 + 2 + 3 . . . + 100 = 5050.

Try the following:

```
DIMA$(500):FOR I = 1 TO 500:A$(1) =
"[10 SPC]":NEXT
```

and then type:

```
A = TI:PRINT FRE(0),INT((TI − A)/.6)/100
```

After a while two figures will appear. The first is the amount of free memory and the second is the time in seconds for the "Collection". Now type CLR and try bigger values for the size of A$.

Some hints for decreasing the frequency of Garbage Collections. Have as much free memory as possible, using those methods stated earlier. If your program uses large amounts of DATA in DATA statements then consider using cassette or disk files for storing it. For every line of DATA removed there is an overall saving of six bytes, plus the physical data removed. When information is no longer needed destroy it. Consider an array holding the days of the week and months of the year. Once the array is no longer needed then over 120 bytes of memory are tied up containing the data. A short loop setting all the elements to a null value will free the 120 bytes after the next Garbage Collection.

For a variety of reasons, it sometimes occurs that strings have to be padded out to a common length. There are two methods of doing this.

1. Use a FOR-NEXT loop to append spaces:

```
FOR I = 1 TO 25 — LEN(A$):A$ = A$+
" ":NEXT
```

2. Use of LEFT$:

```
A$ = A$ + LEFT$(SP$,25 − LEN(A$))
```

The second method assumes the existence of the string SP$ containing at least 25 spaces. It is by far the better of the two as it is quicker, always works for A$ greater in length, it is shorter to write and doesn't use up to 325 bytes (worst case) of free memory, as the first one does. ●

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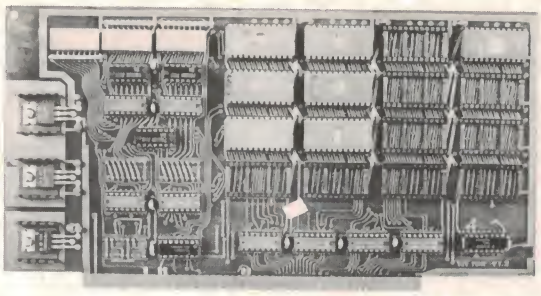

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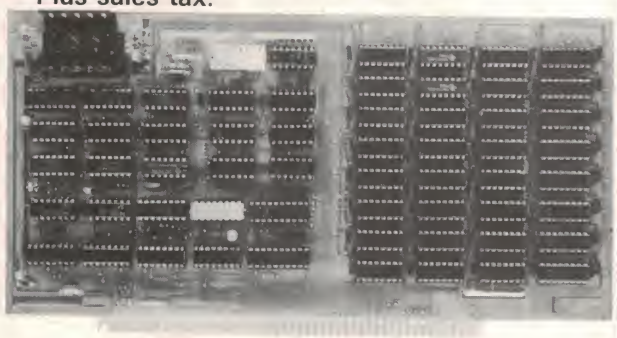

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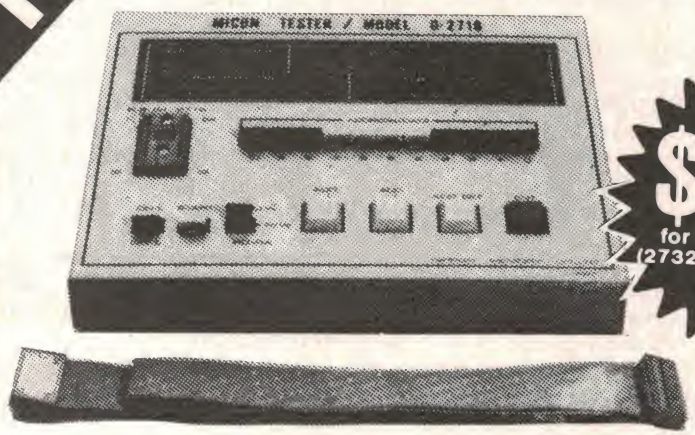

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How to hex your UK101

For those into machine code programming on the UK101 board, this little program will allow you to begin at your start address in memory and look at the next 104 memory locations.

Martyn Croft

HERE IS a simple program for anyone contemplating machine programming on the UK101. Development of a complex machine code program is undoubtedly made easier by using the extended monitor supplied with the computer. However, small machine code programs can be written out and entered under the monitor available in ROM. Unfortunately, to inspect the program one has to step through the memory locations one by one, checking the contents of each location. This is both tedious and fraught with disaster.

The program listed allows you to simply enter the starting address of your program (or any other section of memory for that matter) and view on the screen the next 104 memory locations. Using two nested FOR . . .NEXT loops, the program PEEKs the required location, converts the decimal value to hex using subroutine 1000, and prints a table of the memory contents. The address is also converted to hex and displayed at the start of every line, that is, preceding every set of eight memory locations. The UK101 screen comfortably allows 13 such lines, hence the 104 locations.

Thus, with a screen full of hex digits it becomes a relatively simple matter to check a machine code program, if not all at once, then in fairly large portions. ●

Program listing

```
 80 INPUT"STARTING ADDRESS";S
 90 IF (S-INT(S)<>0) OR (S<0 OR S>65535) THEN 80
100 PRINT
110 FOR L=S TO S+96 STEP 8
120 N=L:HI=3
125 PRINT TAB(3);
130 GOSUB 1010
140 PRINT" ";
150 FOR A=L TO L+7
155 IF A>65535 THEN PRINT:GOTO 210
160 N=PEEK(A):HI=1
170 GOSUB 1010
180 NEXT A
190 PRINT
200 NEXT L
210 PRINT
220 GOTO 80
230 END
1000 REM** DEC TO HEX CONVERSION
1010 FOR I=HI TO 0 STEP -1
1020 H=INT(N/16↑I)
1030 N=((N/16↑I)-H)*16↑I
1040 IF H<=9 THEN D=H+48
1050 IF H>9 THEN D=H+55
1060 PRINT CHR$(D);
1070 NEXT I
1080 PRINT" ";
1090 RETURN
```

ZX80 renumber program

Here's a simple program renumbering routine for your ZX80 that doesn't clutter up the tiny memory space.

A. Beasley

AFTER USING the ZX80 for a few months I found that there was a need for a simple renumbering program. In the attempt to solve the problem a BASIC program was written out but this took far too much memory space. Whilst machine code was the obvious solution it did raise yet another problem. How could the program be stored so that it could be used without any trouble? After attempting to store it in a REM line it was found that some of the codes made the system crash when the program was listed.

Solutions

To get over the problem the following method was developed. First all the variables are CLEARed. A string variable is now set up to contain the required number of bytes and the machine code is POKEd into it. As this string variable is the first in the list its location can be found from the two bytes called VARS; see page 122 in the manual. By adding one to the value obtained you have the location of the first character in the string. To call the program you simply find the value of VARS, add one and use this number as a USR call.

```
1    CLEAR
2    LET Z$ = "aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa"
3    LET A$ = "06000E0A2128407023713E0A814F300404
     CB70C0237EFE7620FA237ECB7FC018E6"
4    LET A = 1 + PEEK(16392) + PEEK(16393*256)
5    FOR C = 1 TO 33
6    LET B = CODE (A$) – 28
7    LET B = B*16
8    LET A$ = TI$(A$)
9    LET B = B + CODE(A$) – 28
10   LET A$ = TI$(A$)
11   POKE A,B
12   LET A = A + 1
13   NEXT C
```

More problems

This method generates its own set of problems, however. If you are using it for program operation you cannot use the following commands: RUN, CLEAR or NEW. By using GOTO you can get over the RUN problem and the others are not really drastic.

The main advantage of this method is that when you save the program you still preserve the string for the next time. It should be noted that the GOTO and GOSUB statements are not altered but you do get everything into 35 bytes.

Operation

To use the program type in with Z$ containing 33 characters, run the program, then remove it by typing just the line numbers and then 'Newline'. The program you wish to renumber can be keyed in, but remember not to use the RUN or CLEAR keys and make sure that the program does not contain Z$.

To activate the renumber type PRINT USR (1+PEEK(16392)+PEEK(16393)*256). ●

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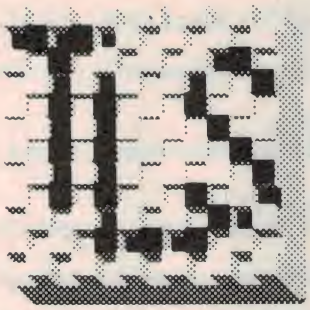

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Memory-mapped sound generator

W.S. Maggs

HERE IS A CIRCUIT idea for using AY-3-8910 Programmable Sound Generator (PSG) chips on an Apple buss.

The usual way of interfacing these chips to microprocessors is by using PIAs. However, I wanted to remove the additional burden and wastefulness of programming PIAs by memory-mapping the PSG. This is done as follows: from the data sheet, pins BC1, BC2 and BDIR control the chip operation (see Table 1).

It can be seen that if BC2 is taken to +5 V then only BC1 and BDIR control the chip. I tried various gate layouts but these failed. Finally I used a dual 4-line to 1-line data selector (74LS153), each side controlling BC1 and BDIR respectively.

To control the 74LS153 I used the R/$\overline{W}$ and A0 lines of the Apple on the A and B inputs. The inhibit input was selected by a signal from the 7442 so that the 153 was only selected if the '0' output of the 7442 was low (see Table 2).

The selection of the 7442 is an easy matter on an Apple buss because each slot has a line $\overline{DEV}$ which selects one of 16 addresses. To make programming easier the reset pin of the PSG is also memory-mapped. The OR gate on output '1' of the 7442 makes sure the reset is only selected by one address.

A simple program to test the chip is given. Since the PSG requires a register address first, then the data for the register, the register address (latch address) is mapped C0X0 (where X is the slot number +8). The data is then read or written to C0X1 with the reset on C0X2. Resetting the PSG clears all registers. In the program the data is held at 2000 hex, with the number of registers used in 2000, followed by the data and then the registers (hi ◗ lo). To reset the PSG a dummy store is used.

Since the load requirements of the Apple buss are fixed, the R/$\overline{W}$ line is buffered to enable two PSGs to be used. The I/O ports of the PSG can either be used as extra PIAs or to address PROMs. The signal outputs of the three channels of the PSG drive a conventional audio amplifier. I used an LM380. ●

SHORT CIRCUITS is a feature that lies somewhere between Ideas for Experimenters and complete Projects. Generally, the items published in Short Circuits will involve tried circuits that have not necessarily been fully developed, but fairly complete details are included as a guide to readers. Unfortunately, owing to the nature of these items, we cannot give further details other than what is provided in the article. Contributions for Short Circuits are always welcome.

The AY-3-8910 can be obtained from Watford Electronics, 33/35 Cardiff Rd, Watford, Herts, UK, or Technomatic, 17 Burnley Rd, London NW10, UK. Cost: around £9 mail order.

Program for frequency 440 Hz

```
1000  8D C2 C0    STA $ C0C2
      AC 00 20    LDY $ 2000
      BE 04 20    LDX $ 2004, Y
      B9 00 20    LDA $ 2000, Y
      8E C0 C0    STA $ C0C0
      8D C1 C0    STA $ C0C1
      88          DEY
      D0 F1       BNE $ 1006
      60          RTS
2000  04 0F 3E 00 FE 08 07 01 00
```

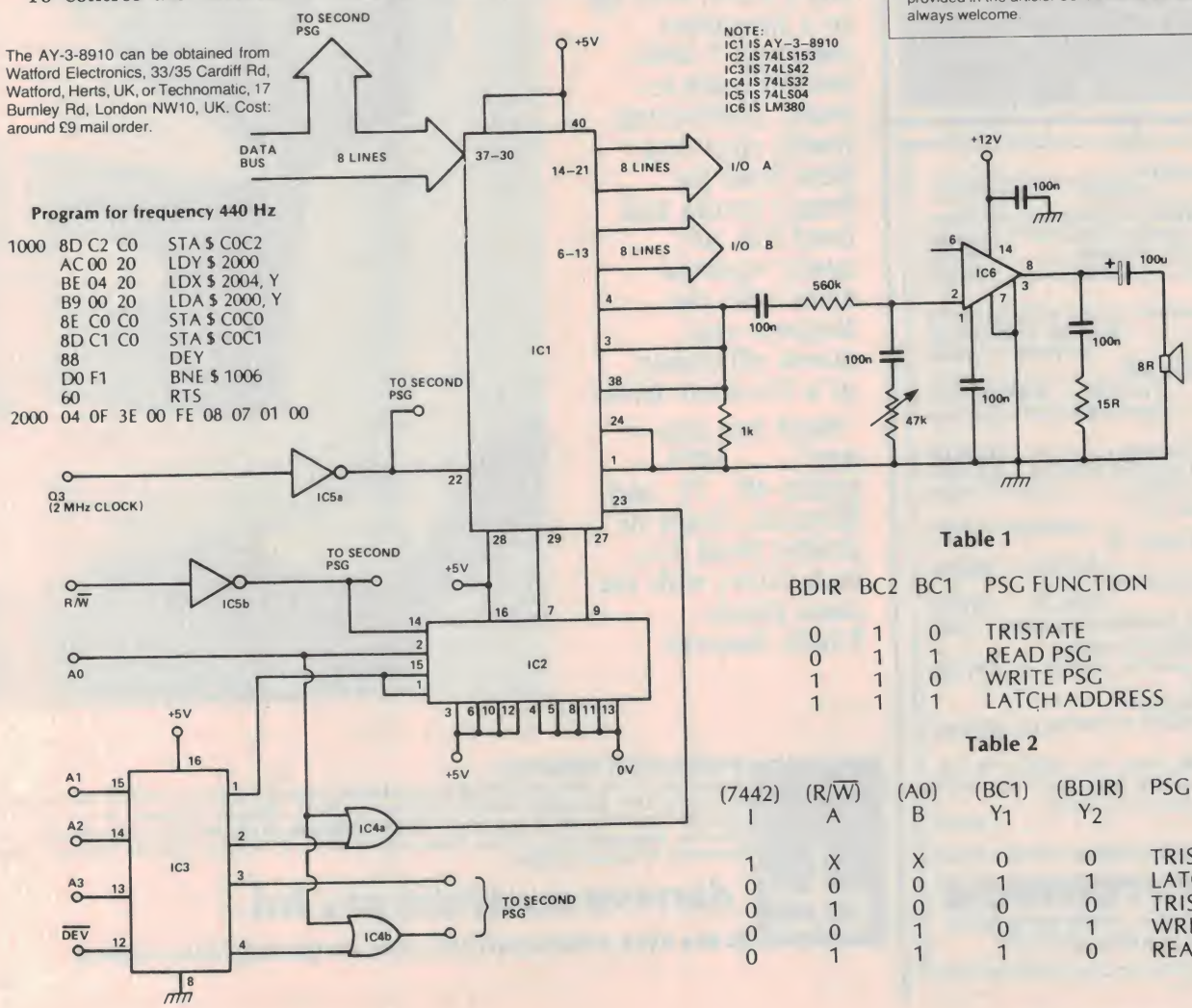
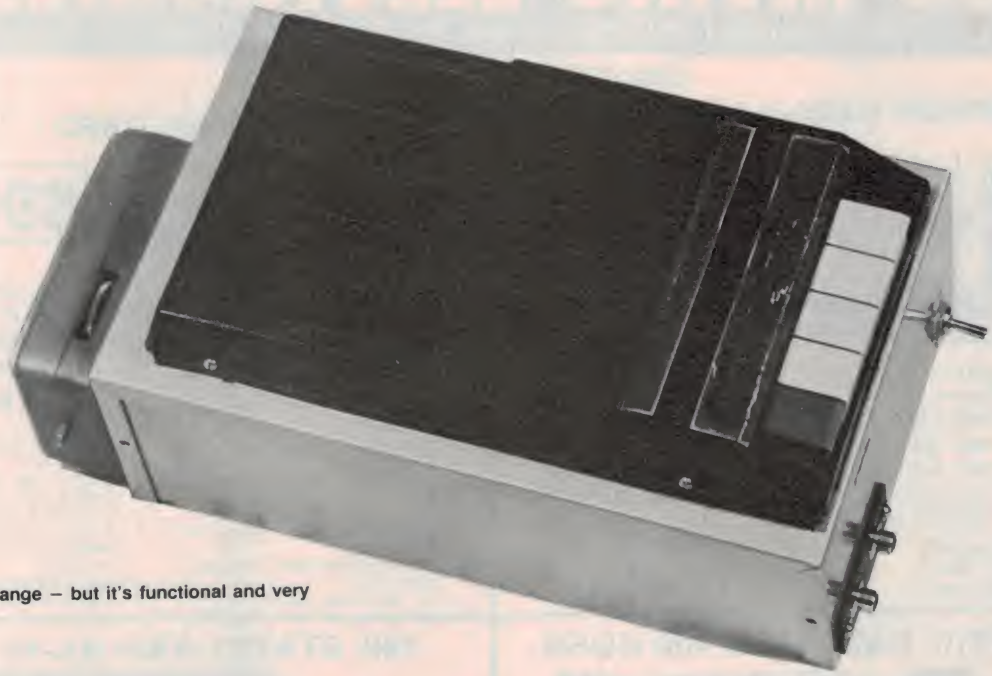


Table 1

BDIR	BC2	BC1	PSG FUNCTION
0	1	0	TRISTATE
0	1	1	READ PSG
1	1	0	WRITE PSG
1	1	1	LATCH ADDRESS

Table 2

(7442) I	(R/$\overline{W}$) A	(A0) B	(BC1) Y_1	(BDIR) Y_2	PSG
1	X	X	0	0	TRISTATE
0	0	0	1	1	LATCH ADD
0	1	0	0	0	TRISTATE
0	0	1	0	1	WRITE PSG
0	1	1	1	0	READ PSG



I know, it looks strange – but it's functional and very reliable!

Reliable cassette recorder for your computer

With very little effort a vast improvement can be made in the reliability of the much-maligned cassette recorder in computer storage applications.

Graham Wideman

HOW MANY TIMES have you been in the situation where you've tried to load 15 minutes' worth of software from cassette into your computer, and just at the end you see "CHECKSUM ERROR" (or whatever dreaded way your computer tells you)? You feel like ripping the cassette recorder off the desk by the cables and throwing it out of the window. After a while this solution to the problem gets expensive, so here are a few suggestions to help improve the dilemma.

Why does it mess up?

There are a variety of ways that you can get frustrated with your cassette recorder data storage device. There's the problem that when you plug the cables into your recorder, you can't hear what's coming off or going onto the tape because plugging in causes the speaker to cut out. This can mean that you were expecting one thing to happen, and it doesn't, and you don't find out till much later. We'll show you how to get around that.

Then there is one of the major and surprisingly frequent causes of failure: poor or loose connections. We'll also show you how to get around that.

Understanding the poor cassette

Unfortunately, the average cassette recorder was not built for recording data; it was made for recording speech and music. The requirements for the two are quite different. In the former case we are not too interested in fine fidelity or tone colouring, but we're very very interested in continuity and constant performance, and we can't afford to lose any bits. The cassette recorder was designed, however, with little regard for reliability of connectors or constant reproduction characteristics, since the ear won't notice momentary disturbances. However, some attempt may have been made to squeeze pleasant sounds out of the tiny speaker provided, i.e: tone modification or controls.

The bottom line is that quite an improvement can be made to the average recorder at very little expense, and its understandable deficiencies corrected.

Connection corrections

The most fruitful place to start the improvements is in the connections department. Take a look at your recorder set-up, and see how many connections have to be maintained perfectly in order for your SAVE-LOAD operation to be a success: two for each plug, two plugs for each cable to the computer. Then there's the ac adaptor with a plug into the wall and a plug into the recorder, or maybe you have batteries which average two contacts each. Not to mention hidden contacts, such as the ones in the socket which is normally used for remote control of the recorder, and which carries the power to the recorder workings even when no mike is in use. Typically you end up with at least twelve opportunities for an intermittent connection. ▶

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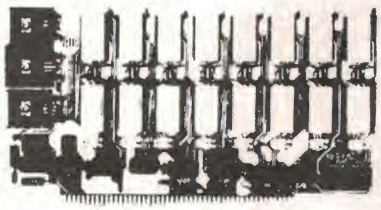

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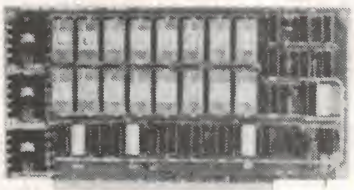

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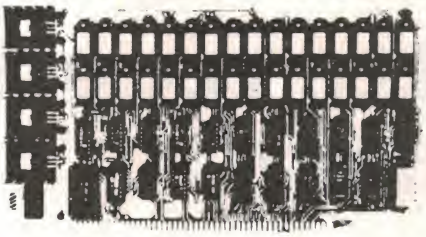

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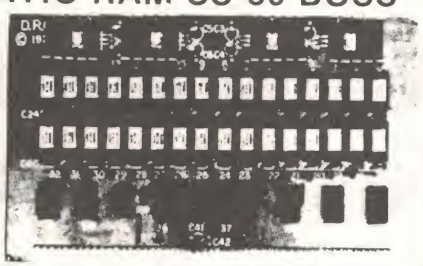

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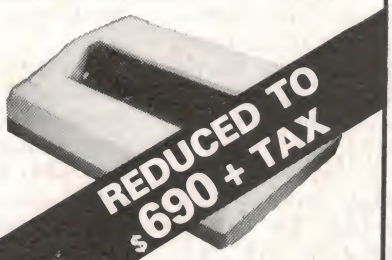

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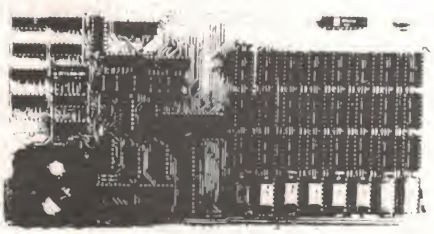

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Some of these connections we cannot do without. However, there are some which can be disposed of completely and others which can be improved by changing the style of plug. Particular culprits are the plug-and-sockets often used with ac adaptors, and especially the small round 'phono' plugs used for the mike and earphone connections.

The preferable method for correcting these problems is to rather radically customise your recorder. First, of course, find a recorder which works at least reasonably well with your computer. The best choices seem to be those that are not *too* expensive, don't have tone controls, but do have some kind of automatic level control. Decide that the recorder is going to be sacrificed (er, I mean *dedicated*) to the computer. Now you can start work.

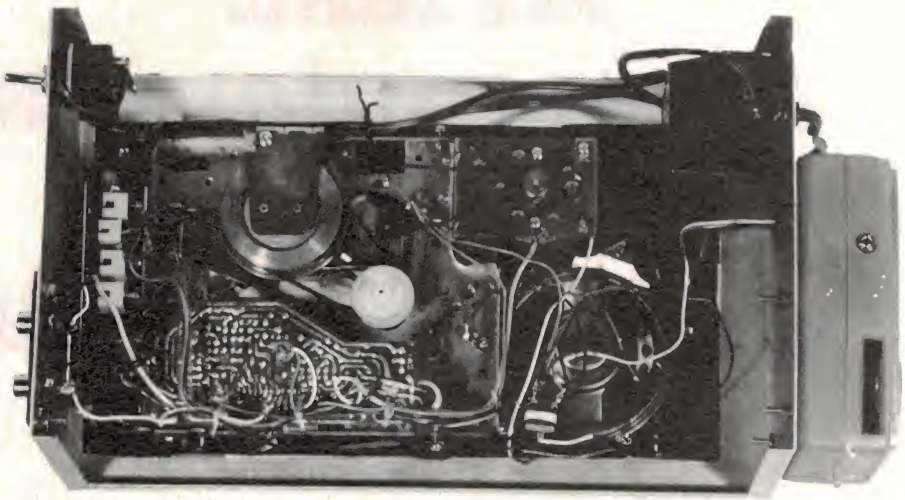
Since you are going to be changing sockets, possibly building in some more switches and so forth, it's a good idea to attach onto the recorder a metal box to accommodate these extras. This should be done in a way which will make wiring easy and neat.

The connectors to the computer are the first to go. Either wire the computer cables direct to the earphone (ignore the leads to the speaker) and mike wires (or auxiliary input depending on your computer), or install RCA phono sockets or 6 mm phono sockets, all of these being far more suitable than the original toy sockets. Next attend to the power supply. My favourite way to deal with this is to take an ac adaptor and fix it inside the new cassette recorder box, permanently wiring on a line cord (with optional on/off switch, fuse and indicator light), and wiring the adaptor output direct to the cassette recorder power input lines. It's also an idea to throw in a hefty power supply capacitor, say a few thousand microfarads (12 V electrolytic) across the power supply for good measure.

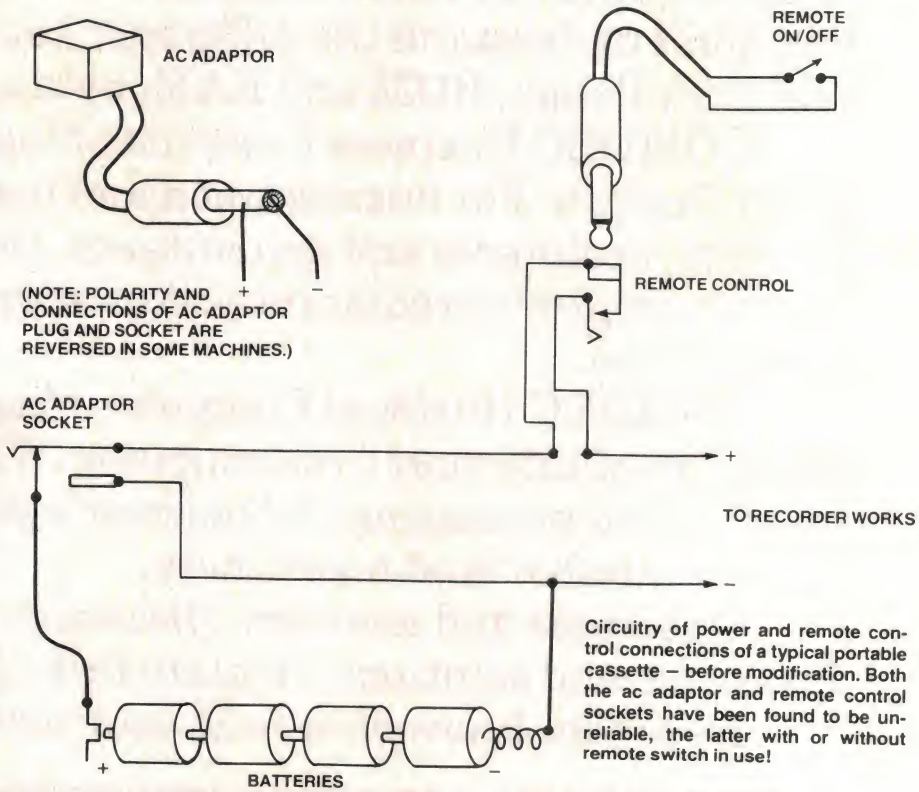
Hearing what's going on

The above takes care of the loose connections problem. Now for a quick way to add sound to input and output operations.

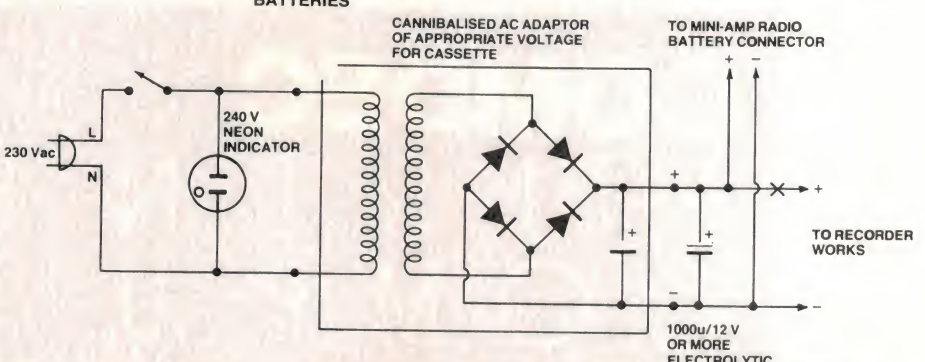
The signals we want to hear are present at the earphone jack, both when playing or recording. (When recording most cassette machines allow you to monitor what's going onto the tape via an earphone.) That signal will probably be strong enough to drive a speaker, but the volume control must be set according to the computer's input requirements, and then left alone. If the speaker is then too loud you are stuck with it. You can't even switch the



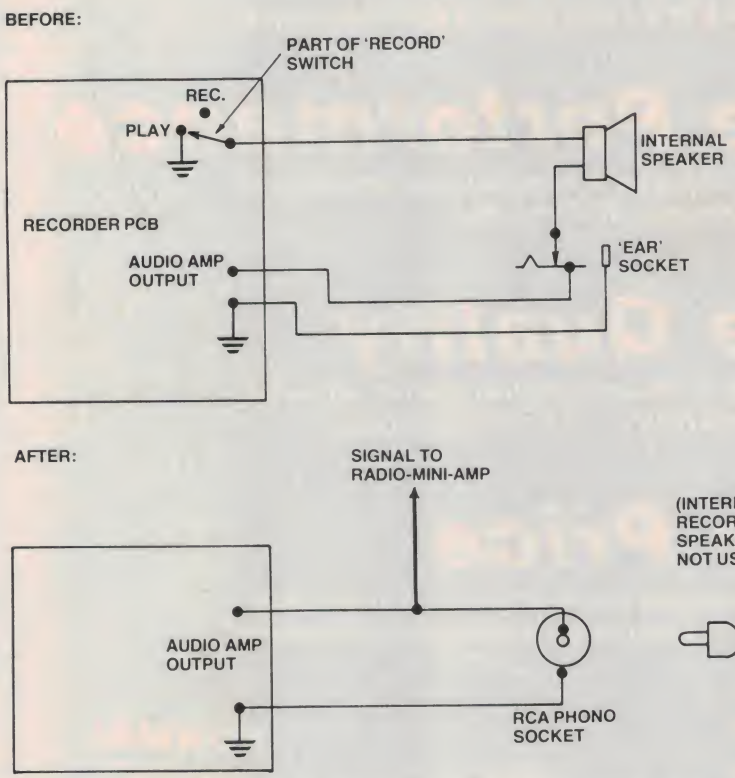
Internal view of the modified unit. Note the plug pack at upper right and the modified transistor radio at the right hand end.



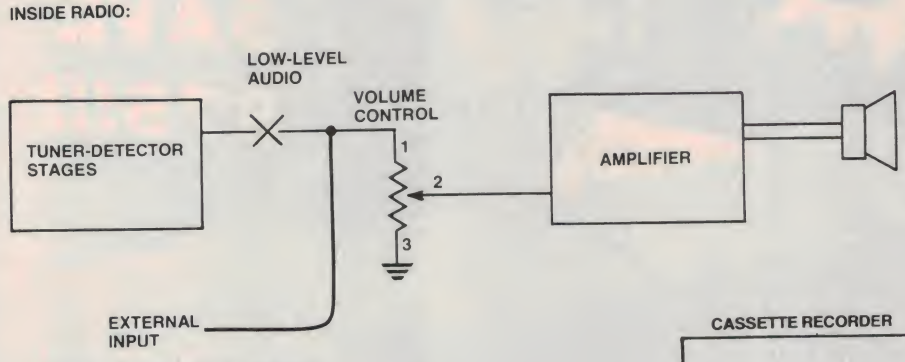
Circuitry of power and remote control connections of a typical portable cassette – before modification. Both the ac adaptor and remote control sockets have been found to be unreliable, the latter with or without remote switch in use!



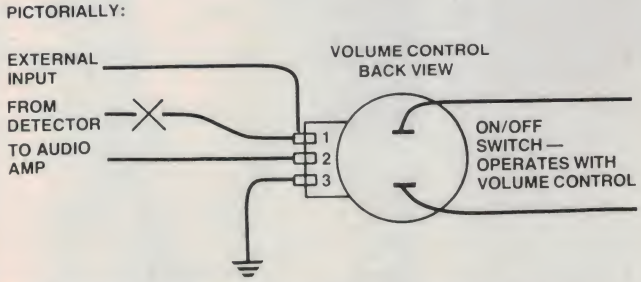
Wire an ac adaptor (plug pack) permanently in place. If computer remote control of start/stop is required, break the +ve lead at X and wire in a reliable socket (e.g: RCA phono). Wire a switch in parallel of an open-circuit socket so you can retain manual control.



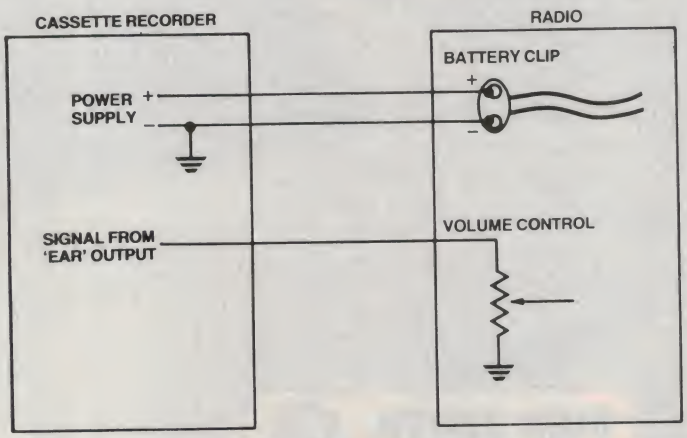
Modifying the cassette recorder for reliable 'ear' output is shown above. An old transistor radio will provide audio output, as explained in the text and the drawings below.



THE IDEA IS TO CUT AT 'X' AND FEED EXTERNAL SIGNAL TO 'TOP' OF VOLUME CONTROL.



NOTE: TERMINALS 1 AND 3 ARE PHYSICALLY REVERSED ON SOME VOLUME CONTROLS (AND DEPENDING UPON FRONT OR BACK VIEW!). TO DETERMINE WHICH IS WHICH, FOLLOW PC BOARD TRACES FROM EACH. THE GROUND FOIL SHOULD WIND ITS WAY ROUND MOST OF THE PC BOARD AND END UP CONNECTED TO THE NEGATIVE SIDE OF THE BATTERY (POSSIBLY VIA THE SWITCH).



Connections from the cassette recorder to mini-amp radio are shown here. Only three connections are necessary. Don't bring across a separate ground lead for the signal connection. Note this setup assumes that both recorder and radio are −ve earth circuits. To check this see that the 'low' end of the volume control in each connects to the −ve supply lead.

speaker in and out when needed, because the load of the speaker, or lack of it, will change the level of the signal going to the computer.

A far better way to deal with the situation is to take the signal from the earphone wire and amplify it independently. The cheapest way to do this is to purchase a cheap, tiny transistor radio for $4 or so, and convert it (as shown in the accompanying diagrams) into a mini amplifier. The earphone signal is permanently wired as the input to the radio-amplifier, and the radio can be powered from the recorder's ac adaptor power supply. The volume level of the sound which now plays through the radio's speaker is adjusted by the radio's volume control, and doesn't affect what the recorder is doing.

Some last words

There's still room for improvement. You should figure some way of semi-permanently fixing the recorder volume control at a satisfactory setting. I swallow my pride and buy commercially made hi-fi cables to join my recorder and computer, on the basis that the plugs are probably more reliably attached than I could do. You might experiment with different types of cassette tape (your computer store should have some tape that works well). But if you started with a recorder that didn't work too badly, the modifications covered here should result in a recorder you can depend on. And when you move up to disk drives and stop using the cassette, make sure there's no-one outside the window when you throw it.●

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LIFE on a 6800

An interesting variant on the popular LIFE emulation specifically for 6800 owners. Designed for the SWT range, it should prove adaptable to other 6800-based machines.

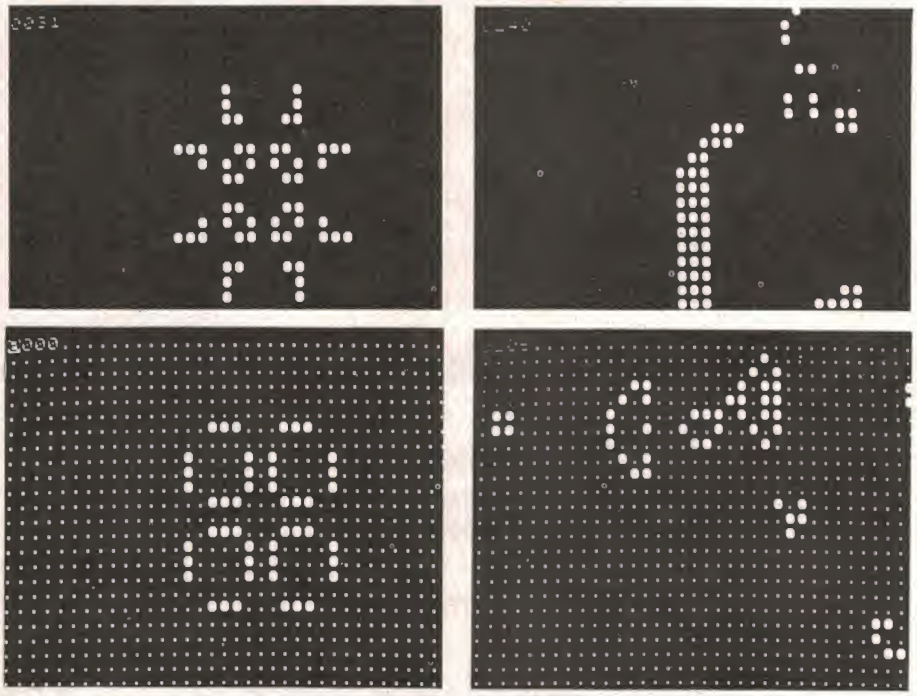
Edwin J. Peffer

THE program LIFE is a set of rules to define the growth or death of a moss-like form. It was devised by J. Conway and depends entirely on the number of 'neighbours' that each cell has, as follows:

A 'live cell' with only two or three neighbours will remain alive, but if there are more or less than this it will die. An empty cell with three neighbours will result in a birth at the empty location. Whether this really proves anything is very doubtful but it is both interesting and amusing. The end result can fall into one of the following categories: a) the whole system dies, b) a stable pattern results (a square of four is an example of this), or c) a cyclic pattern which goes through one or more generations before repeating. The best example of these that I have found starts as three solid rows of cells across the centre of the matrix and this eventually produces a cyclic pattern that takes 15 generations to repeat.

My first program for LIFE was written in BASIC for a Hewlett-Packard 2000F and even on this machine it took 10 seconds per generation. There was a 10 x 10 matrix and the technique was to count the neighbours for every cell in order to determine the next generation, i.e: eight subscripted variables for each of 100 locations. I eventually realised that rather than count for *every* cell it would be quicker to zero a matrix and then add one to each neighbour of a *live* cell (still eight subscripted variables for each cell examined but considerably fewer cells to worry about). After this the counting matrix has a record of the number of neighbours for each cell and the appropriate symbol can be loaded into the printing matrix. This cuts down the time to approximately one second per generation, which was acceptable.

Then the college at which I teach bought a SWTP 6800 system and I modified LIFE to suit the slightly different BASIC. Due to the BASIC's slowness in handling subscripted variables it takes an incredible 50 seconds per generation. Hence my decision to write a machine code version of LIFE.



This is your LIFE!

Method

I settled on a 16 x 16 matrix, although this can be increased or decreased quite easily. To simplify the printing it treats the whole matrix as a single string and uses the Mikbug/SWTbug routine PSTRING (E07E). Thus the string consists of x's or .'s with every 17th and 18th item as 'return', 'linefeed' respectively and the last item is an 'end of string' (code 04). So the string is effectively folded back on itself as shown:

. . . .XXXXX. . . . .ret,l/f. . . .
XXXXX. . . . .ret,l/f. XXXXX
. . . . .ret,l/f. . . . .XX.ret,l/f,eot

As you will see later the whole string gets modified by the calculation process and therefore before actually printing the string the 'return', 'linefeed', etc, characters have to be added in again (program steps 017B to 01A6).

There have to be two matrices: Gen1, which is the present generation, and Gen2, which is used to count the number of neighbours. The first stage in the calculation is to clear Gen2 (subroutine CLGEN2). Then it reads through Gen1 to find a live cell (X). When it does so it sets the index register to the corresponding cell in Gen2 (using subroutine XOFSET). It then has to add one to each of its eight neighbours as shown.

A	B	C
D	X	E
F	G	H

The index register holds the address of X but we cannot address A, B, C or D because indexed address offsets can only be positive, therefore (program steps 01BD to 01CF) it subtracts 19 so that the index register holds the address of A. Now we can increment the contents of A (as X), B (as X + 1), C as (X + 2), D as (X + 18) etc. It does not take into account the fact that edge cells should not affect eight neighbours, which is why the return, linefeed get overprinted and also why the isolation block is necessary. After this has been carried out for all of Gen1 then Gen2

contains the list of all the neighbours.

The subroutine NEWGEN is now used to load the next generation, taking into account how many neighbours and whether a cell is already alive or dead. Note that once again it does not identify locations 17 and 18, etc, and so they will have to be modified as described above. It then goes back and repeats from CLGEN2.

The input routine is possibly more complex than necessary but I have found it very frustrating in the past to run LIFE on a VDU and find an interesting sequence, but then realise that I hadn't noted the initial pattern. With my routine, it first clears the screen, then prints the message and then prints 27 blank spaces before accepting and printing each character as it is input. After 16 characters it gives 'return, linefeed' and 27 spaces, etc. The result is that the initial pattern is offset 27 spaces to the right and remains there whilst leaving sufficient space for the main display to be watched. If you like the result then you still have a copy of the original pattern.

Finally, why the time delay? Well, it is so fast that on a 960 char/sec VDU the display is continually changing and can't really be seen. Counting down from FFFF gives a delay of about 1 s between generations. If you don't want the delay, replace 0116 and 0117 with 00 01.

This version of LIFE assumes a flat universe bonded by the edges of the matrix. A variation which could be added is to assume the opposite edges to be adjacent (similar to a Karnaugh map) so that the universe is a sort of sphere. It is, however, *not* a true sphere as the geometricians among you will have realised.

Program Listing

```
                        NAM CONLIFE
0100                    ORG $0100
                        OPT PAG
0100 86 16              LDA A #$16      CLEAR SCREEN
0102 BDE1 D1            JSR OUTCH       PRINT THE CHARACTER
0105 BD01 2C            JSR INPUT       REQUEST INITIAL PATTERN
0108 86 1D      MAIN    LDA A #$1D      HOME THE CURSOR
010A BDE1 D1            JSR OUTCH       PRINT THE CHARACTER
010D 86 19              LDA A #$19      DELETE TO END OF LINE
010F BDE1 D1            JSR OUTCH       PRINT THE CHARACTER
0112 BD01 7B            JSR PRINT       PRINTING ROUTINE
0115 CE FF FF           LDX #$FFFF      START OF DELAY LOOP
0118 09         DECREX  DEX
0119 26 FD              BNE DECREX      FINISH DELAY LOOP
011B BD01 ED            JSR CLGEN2      SET GEN2 TO ZERO
011E BD01 AE            JSR COUNT       COUNT THE NEIGHBOURS
0121 BD01 FC            JSR NEWGEN      SET UP NEXT GENERATION
0124 86 0A              LDA A #$0A      LINE FEED
0126 BDE1 D1            JSR OUTCH       PRINT THE CHARACTER
0129 7E 01 08           JMP MAIN        REPEAT MAIN LOOP
                *       INPUT ROUTINE
012C CE 02 45   INPUT   LDX #MESSG      INITIAL MESSAGE
012F BDE0 7E            JSR PSTRING     PRINT IT
0132 CE 02 63           LDX #SHIFT      27 SPACES
0135 BDE0 7E            JSR PSTRING     PRINT IT
0138 CE 02 93           LDX #GEN1       START OF GEN1
013B 7F 02 44           CLR ROW         CLEAR ROW COUNTER
013E 7F 02 43   INPUT2  CLR LINE        CLEAR LINE COUNTER
0141 BDE1 AC    INPUT1  JSR INCHR       ACCEPT CHAR FROM KEYBD
0144 A7 00              STA A X         STORE IT
0146 08                 INX             INCREMENT INDEX
0147 7C 02 43           INC LINE        INCREMENT LINE COUNT
014A B6 02 43           LDA A LINE      PUT LINE COUNT IN ACCA
014D 81 10              CMP A #16       IS IT END OF LINE?
014F 26 F0              BNE INPUT1      NO--ASK FOR NEXT CHAR
0151 86 0D              LDA A #$0D      CARRIAGE RETURN
0153 BDE1 D1            JSR OUTCH       PRINT THE CHARACTER
0156 A7 00              STA A X         STORE CARRIAGE RETURN
0158 08                 INX             INCREMENT INDEX
0159 86 0A              LDA A #$0A      LINEFEED
015B BDE1 D1            JSR OUTCH       PRINT THE CHARACTER
015E A7 00              STA A X         STORE LINEFEED
0160 08                 INX             INCREMENT INDEX
0161 FF 02 41           STX TEMPX       SAVE INDEX
0164 CE 02 63           LDX #SHIFT      27 SPACES
0167 BDE0 7E            JSR PSTRING     PRINT IT
016A FE 02 41           LDX TEMPX       GET INDEX
016D 7C 02 44           INC ROW         INCREMENT ROW COUNTER
0170 B6 02 44           LDA A ROW       LOAD ROW NUMBER TO ACCA
0173 81 10              CMP A #16       IS IT END OF FRAME?
0175 27 03              BEQ RET1        YES--BACK TO MAIN LOOP
0177 7E 01 3E           JMP INPUT2      NO--START THE NEXT LINE
017A 39         RET1    RTS
                *       PRINTING ROUTINE
017B CE 02 93   PRINT   LDX #GEN1       START OF GEN1
017E FF 02 41   PRINT1  STX TEMPX       SAVE INDEX
0181 86 0D              LDA A #$0D      CARRIAGE RETURN
0183 A7 10              STA A 16,X      STORE IN 16TH LOCATION
0185 86 0A              LDA A #$0A      LINE FEED
0187 A7 11              STA A 17,X      STORE IN 17TH LOCATION
0189 8C 03 A1           CPX #GEN1+270   END OF FRAME?
018C 27 15              BEQ PRINTE      PRINTE
018E 86 12              LDA A #18       LOAD 18 TO ACC
0190 5F                 CLR B           LOAD ZERO TO ACCB
0191 BB 02 42           ADD A TEMPX+1   ADDS 18 TO INDEX
0194 F9 02 41           ADC B TEMPX     I.E. SETS START OF NEXT LINE
0197 B7 02 42           STA A TEMPX+1
019A F7 02 41           STA B TEMPX
019D FE 02 41           LDX TEMPX       NEXT LINE
01A0 7E 01 7E           JMP PRINT 1     MODIFY NEXT LINE
01A3 86 04      PRINTE  LDA A #$04      ADD EOT TO END OF FRAME
01A5 A7 12              STA A 18,X
01A7 CE 02 93           LDX #GEN1       START OF GEN1
01AA BDE0 7E            JSR PSTRING     PRINT THE STRING ▶
```

```
01AD 39                        RTS
                    * COUNTING ROUTINE
01AE CE 02 93  COUNT  LDX #GEN1      START OF GEN1
01B1 A6 00     NEXTX  LDA A X        LOAD IT TO ACCA
01B3 81 58            CMP A #'X      CHECK FOR LIVE
                                     CELL
01B5 26 2C            BNE NOT        NO--TRY NEXT
                                     CELL
01B7 FF 02 41         STX TEMPX      YES--SAVE INDEX
01BA BD02 2A          JSR XOFSET     GET LOCATION OF
01BD B6 02 80         LDAA TEMPX1+1  CORRESPONDING
                                     POINT
01C0 F6 02 7F         LDA B TEMPX1   ON GEN2
01C3 80 13            SUB A #19      MOVE TO POINT
                                     THAT
01C5 C2 00            SBC B #0       IS ONE ROW UP
                                     AND
01C7 B7 02 80         STAA TEMPX1+1  ONE COLUMN
                                     LEFT IE
01CA F7 02 7F         STA B TEMPX1   POINT 'A'
01CD FE 02 7F         LDX TEMPX1     LOAD IT TO INDEX
01D0 6C 00            INC X          INCREMENT 'A'
01D2 6C 01            INC 1,X        INCREMENT 'B'
01D4 6C 02            INC 2,X        INCREMENT 'C'
01D6 6C 12            INC 18,X       INCREMENT 'D'
01D8 6C 14            INC 20,X       INCREMENT 'E'
01DA 6C 24            INC 36,X       INCREMENT 'F'
01DC 6C 25            INC 37,X       INCREMENT 'G'
01DE 6C 26            INC 38,X       INCREMENT 'H'
01E0 FE 02 41         LDX TEMPX      BACK TO GEN1
01E3 08        NOT    INX            INCREMENT INDEX
01E4 8C 03 B4         CPX #GEN1+289  END OF FRAME?
01E7 27 03            BEQ RET4       YES--BACK TO
                                     MAIN LOOP
01E9 7E 01 B1         JMP NEXTX      NO--GET NEXT
                                     LOCATION
01EC 39        RET4   RTS
                    * ROUTINE TO SET GENERATION#2 TO ZERO
01ED CE 03 C6  CLGEN2 LDX #GEN2      START OF GEN2
01F0 8C 04 E7  CLR    CPX #GEN2+289  END OF FRAME?
01F3 27 06            BEQ RET3       YES--BACK TO
                                     MAIN LOOP
01F5 6F 00            CLR X          NO--SET CELL TO
                                     ZERO
01F7 08               INX            INCREMENT INDEX
01F8 7E 01 F0         JMP CLR        NEXT CELL
01F8 39        RET3   RTS
                    * ROUTINE TO LOAD THE NEXT GENERATION
01FC CE 02 93  NEWGEN LDX #GEN1      START OF GEN1
01FF FF 02 41  AGAIN  STX TEMPX      SAVE IT
0202 BD02 2A          JSR XOFSET     CORRESPONDING
                                     CELL IN GEN2
0205 A6 00            LDA A X        LOAD CELL
                                     CONTENT TO
                                     ACCA
0207 81 03            CMP A #03      CHECK FOR THREE
                                     NEIGHBOURS
0209 27 0E            BEQ NEIGH3     YES
020B 81 02            CMP A #02      CHECK FOR TWO
                                     NEIGHBOURS
020D 27 11            BEQ INX        YES
020F 86 2E            LDA A #'       LOAD '.' TO ACCA
0211 FE 02 41         LDX TEMPX      CELL LOCATION IN
                                     GEN1
0214 A7 00            STA A X        PUT '.' IN CELL
0216 7E 02 20         JMP            INX
0219 86 58     NEIGH3 LDA A #'X      LOAD "LIVE CELL"
                                     TO ACCA
021B FE 02 41         LDX TEMPX      CELL LOCATION IN
                                     GEN1
021E A7 00            STA A X        PUT 'X' IN THE
                                     CELL
0220 FE 02 41  INX    LDX TEMPX      CELL LOCATION IN
                                     GEN1
0223 08               INX            NEXT CELL
0224 8C 03 C6         CPX #GEN2      END OF FRAME?
0227 26 D6            BNE AGAIN      NO--CHECK NEXT
                                     CELL
0229 39               RTS            YES--RETURN TO
                                     MAIN LOOP
          ROUTINE TO OFFSET TEMPX (TEMPX1 = TEMPX + 307)
022A FF 02 7F  XOFSET STX TEMPX1     SAVE INDEX
022D 86 33            LDA A #$33     OFFSET OF 307 IE
022F C6 01            LDA B #01      289 + 18
0231 BB 02 80         ADDA TEMPX11+  ADD THE OFFSET
0234 F9 02 7F         ADC B TEMPX1
0237 B7 02 80         STAA TEMPX11+
023A F7 02 7F         STA B TEMPX1
023D FE 02 7F         LDX TEMPX1
0240 39               RTS
0241           TEMPX  RMB 2
0243           LINE   RMB 1
0244           ROW    RMB 1
E1AC           INCHR  EQU $E1AC
0245 49        MESSG  FCC 'INPUT PATTERN, 16 x 16 GRID'
0246 4E 50
0248 55 54
024A 20 50
024C 41 54
024E 54 45
0250 52 4E
0252 2C 20
0254 31 36
0256 20 58
0258 20 31
025A 36 20
025C 47 52
025E 49 44
0260 0D               FCB $0D,$0A,4
0261 0A 04
0263 20        SHIFT  FCC '(19 spaces)'
0264 20 20
0266 20 20
0268 20 20
026A 20 20
026C 20 20
026E 20 20
0270 20 20
0272 20 20
0274 20 20
0276 20 20
0278 20 20
027A 20 20
027C 20 20
027E 04               FCB 4
E1D1           OUTCH  EQU $E1D1
E07E           PSTRING EQU $E07E
E0E3           CONTROL EQU $E0E3
027F           TEMPX1 RMB 2
0281           BLANK  RMB 18          TO ISOLATE THE
                                      MATRIX
0293           GEN1   RMB 289         GENERATION1 (16*
                                      18 + 1)
03B4           BLANK2 RMB 18          TO ISOLATE THE
                                      MATRIX
03C6           GEN2   RMB 289         GENERATION2
END

NO ERROR(S) DETECTED

SYMBOL TABLE:

AGAIN  01FF  BLANK  0281  BLANK2  03B4  CLGEN2  01ED  CLR
CONTRO E0E3  COUNT  01AE  DECREX  0118  GEN1    0293  GEN2
INCHR  E1AC  INPUT  012C  INPUT1  0141  INPUT2  013E  INX
NE     0243  MAIN   0108  MESSG  0245  NEIGH3  0219  NEWGEN
NEXTX  01B1  NOT    01E3  OUTCH  E1D1  PRINT   017B  PRINT1
PRINTE 01A3  PSTRIN E07E  RET1   017A  RET3    01FB  RET4
ROW    0244  SHIFT  0263  TEMPX  0241  TEMPX1  027F  XOFSET
```

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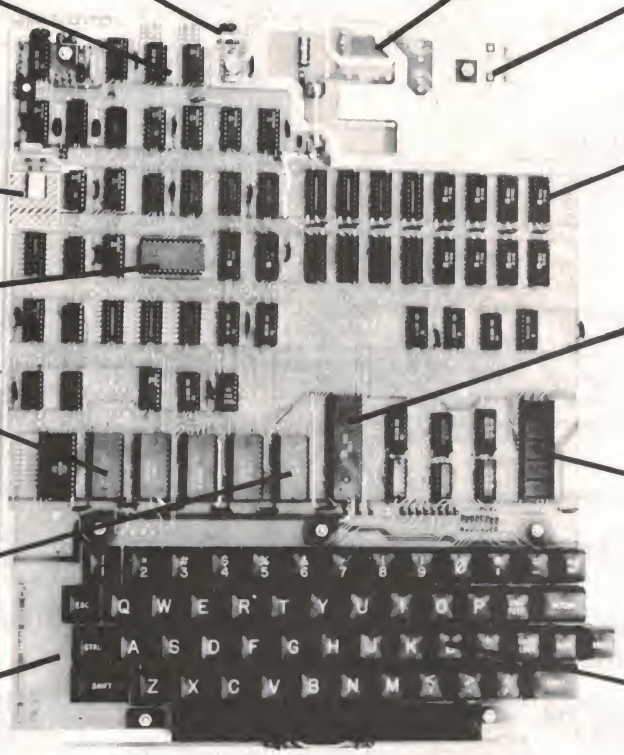

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The incredible shrinking VCR

Although the so-called video war is still raging, with mutters about an industry standard drowned by the battle between the Beta and VHS systems, there are indications that an important new factor, the miniature video camera and recorder, could set things off into a whole new ball game. At least that's how Dennis Lingane sees it after his visit to the US Consumer Electronics Show in Chicago.

The small size of the Beta video cassette, which in the past has seemed to be its weakness, is now proving to be a major advantage in the task of shrinking video recorders to make them more portable.

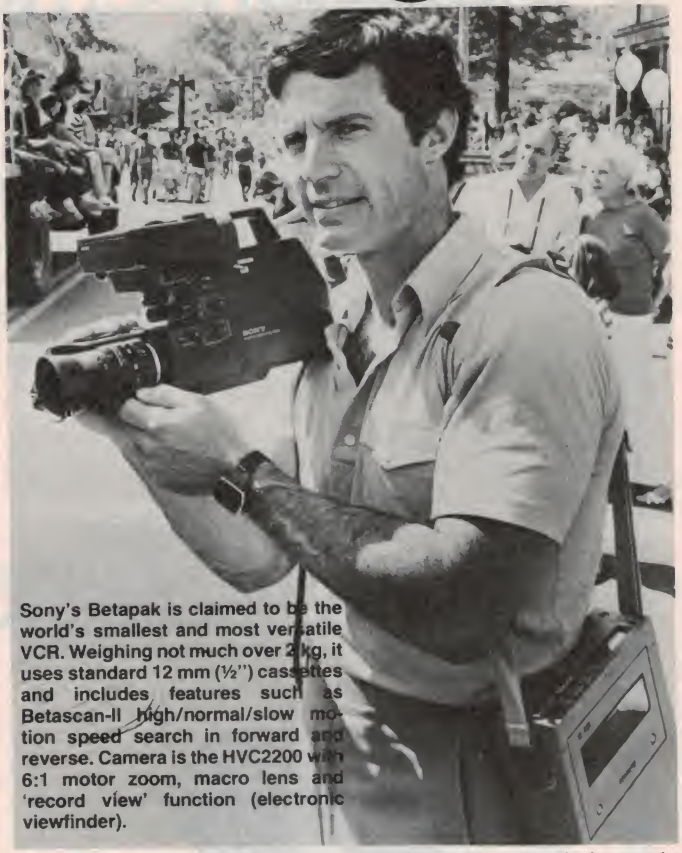
Sony is preparing to release its portable system this year, claimed to be smaller and lighter than any others in the world. It is even slimmer than the cameras of two of its allies in the video war, Toshiba and Sony, who also support the Beta system and showed their new prototype portables at the Consumer Electronics Show. They certainly make the VHS portables look very bulky by comparison.

Certainly in Australia, where Beta already holds over 50% of the market, it looks as if VHS will be fighting a rearguard action over the next few years if the current trend towards miniaturisation and component video is maintained. We could expect to see an early launch of the VHS recorder camera concept that people like Matsushita and Hitachi have already shown prototypes of.

The recorder camera seems destined to replace the 8 mm movie system in the next few years, and in fact the 8 mm market has already stagnated to a degree where Canon has adopted a mini video system developed by Funsai in Japan, and Kodak has cut back on production of 8 mm movie cameras in the USA.

The fact that Kodak has more video patents than anyone else adds greatly to the intrigue in the video world, as Kodak will obviously enter the video war at some time, but as yet no-one has been able to get even a hint out of them as to what they have up their sleeve. However, the cutback on 8 mm production has precipitated a lot of industry rumours that an announcement is imminent.

Despite the fact that the industry is finally talking about sitting round a table to talk about a standard, they may all be too late. The industry is growing so fast that even people in it can no longer predict which way it will jump next and what development will win public approval. The manufacturers and research and development boys are forced to do a constant two-step shuffle trying to make sure they aren't caught on the wrong foot.



Sony's Betapak is claimed to be the world's smallest and most versatile VCR. Weighing not much over 2 kg, it uses standard 12 mm (½") cassettes and includes features such as Betascan-II high/normal/slow motion speed search in forward and reverse. Camera is the HVC2200 with 6:1 motor zoom, macro lens and 'record view' function (electronic viewfinder).

The trend at the moment is towards component video systems with a separate tuner and recorder system, which means we can expect to see a spate of miniature recorder cameras flooding on to the market. In this way the consumer gets the best of both worlds — a home recording system and a portable system for the price of one main recorder.

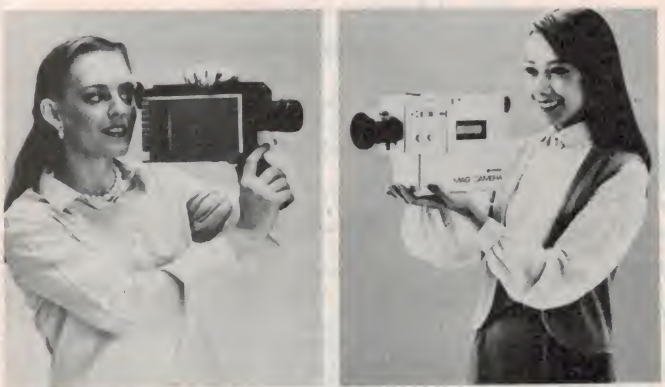
Ultimately he will be faced with buying a second recorder to help him edit his home movies (you need two recorders for this), but the joy of video recorders is that they don't have to be the same format to be dubbed from one to the other. So if a much smaller and lighter portable video system comes out next year the video photographer can leave his heavier unit at home as a permanent installation in his electronic home centre and take out the smaller unit instead. When he gets home he can dub the movies he shot on the smaller recorder on to his bigger one and edit as he goes along.

An extension to the miniaturisation process is the idea of a hip recorder similar in size to the Sony Walkman kind of cassette player (popular with roller skaters, commuters and the like). A separate miniature recorder that clips to a belt would be connected to an equally small solid state camera by a cord, or perhaps the tiny recorder could plug into the back of the camera to make a one-piece recording unit. At home you would simply unplug the recording section of the unit and plug it into the TV set. Neat?

As I said earlier, nobody has a clue where this video industry is going next. All you can do is grin, bear it and enjoy it, as it's pointless putting off buying a recorder till it's all sorted out.

Indications are that it never will be.

Dennis Lingane



Latest development is putting the recorder into the camera — which features all solid-state technology! Matsushita (National Panasonic's parent) say their new micro camera/VCR (left) is the world's smallest and lightest. Using a 'charge priming device' image sensor, it can record up to 2 hours on its 6 mm cassette, weighs 1.9 kg and draws just 4.9 W. Hitachi's rival 'MAG' camera/VCR uses a single-chip MOS sensor, can also record up to 2 hours on its 6 mm cassette, weighs 2.6 kg and draws 7 W.

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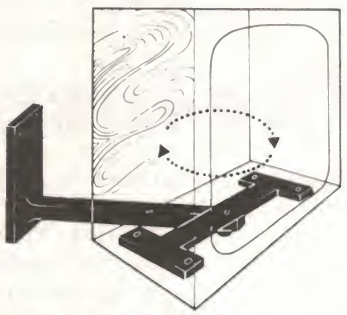

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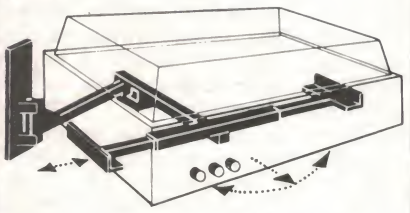

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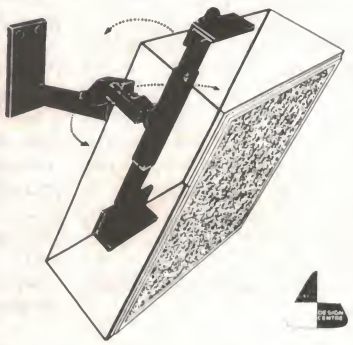

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Sony's C.E. Show

Totally undaunted and unaffected by the collapse of the Sydney Consumer Electronics Show, Sony mounted their own $1.5 million extravaganza in the last week of June at Sydney's Centrepoint.

A well-staged press campaign gained them a lot of coverage in the local media, and Sony were lucky enough to pick a 'slow' news week.

The four-day show attracted over 100 000 visitors, according to Sony, who flocked to see the latest they had to show in video, hi-fi, car sound and consumer goods of all descriptions.

Amongst the myriad of new releases were the 'no frills' SL-C5 Betamax recorder, to complement the SL-C7EC, and a tiny new Walkman cassette player, the WM-2.

We'll be bringing you more on new Sony products in the months to come. Stay tuned.

Sanyo's surprise!

Sanyo swooped on Sydney in July with a brassy press release and dealer show packed with a number of surprises for the audio and video markets.

They flew in 400 dealers from around Australia, along with members of the electronics press, and hit us all between the eyes with a stunning audio/visual show featuring singer Kerry Wood and Roland the robot! But they weren't the surprises.

Sanyo is to launch a laser videodisc system here next April, seven or eight months or more ahead of the planned release of the systems from Philips and Pioneer. But what about software?

Philips plan to have several hundred titles ready for the release of their Pal laserdisc system in Europe next month. Their UK factory will be the only one making Pal software for the laserdisc system and titles probably won't be available in Australia until Philips and Pioneer hit the market with their units.

If Sanyo's left hook with the laserdisc sytem weren't enough, they plan to follow with a right cross and release a VHD player here some months later! Developed by JVC and adopted as the 'standard' in Japan, VHD is supported by all the big Japanese electronics manufacturers, and we understand software is on the horizon.

It's going to be interesting!

Stolmack to handle Linn Sondek and Naim

Warren Stolmack, well-known identity in the hi-fi industry, has launched his own company, simply called 'Stolmack', and will be importing and promoting Linn Sondek and Naim equipment in Australia now.

Distribution will be substantially through the same dealers who have handled the equipment in the past, and Warren says some new dealers will be joining the 'clan'. He tells us he doesn't envisage any significant price changes at present. A feature the company will be promoting will be service and parts back-up, regarded as necessary with equipment of this standard and standing.

For those wanting to update their old Linn turntables, the 'Nirvana' kit is again available, and for around $19 the producers claim it will make a significant improvement through providing better mounting hardware and an improved drive belt.

Linn will have a new low-cost arm and cartridge available shortly and we hear Naim are into making moving coil cartridges. More details when they come to hand.

Stolmack are located at 44 Romney Rd, St. Ives NSW 2075. (02)440-8441.

Technics go with dbx

Two new stereo cassette decks are to be released here by Technics carrying the dbx type II noise reduction system along with conventional Dolby B.

Setting themselves apart from most of the cassette market contenders, who are generally featuring Dolby B/C in this year's crop of releases, Technics feel the demand for high-quality recordings – which includes an increasing number of dbx-encoded discs and tapes – will put these units a pace ahead of the rest of the field because of the performance capability they offer.

The two decks are model RS-M270X and RS-M240X respectively. Technics claim the dbx circuitry included provides 110 dB dynamic range with at least 30 dB noise reduction and a signal-to-noise ratio of 91 dB.

Other features include direct drive and solenoid control on the M270X, soft-touch controls on the M240X. Both have peak-hold fluorescent meters and metal tape capability.

Speakers for the digital era

Melbourne speaker manufacturer, Dynaudio (Aust.) Pty Ltd, claim their range of two-way and three-way systems provides the necessary capabilities and performance to handle the extra performance demands of digital discs.

Dynaudio make three systems: a two-way, model 20-55, using a 210 mm diameter bass unit in an optimised vented enclosure and a 28 mm dome tweeter; a three-way, model 25-90, employing the same bass driver (vented enclosure again) as the 20-55 with a 54 mm mid-range and a 21 mm tweeter; and model 30-90, the largest, employing a 300 mm bass unit in a sealed enclosure.

The Danish-made drivers feature voice coils wound with hexagonal cross-section wire for greater winding density, said to be more efficient thermally and to provide better rise time and sensitivity. Ferrofluids are employed to improve heat dissipation in the voice coils, damp resonances and reduce colouration, according to the makers. Dynaudio also claim their special 'dynamic transient linearity' (DTL) construction system improves rise time, reduces intermodulation distortion and flattens the voice coil impedance curve.

Boxes for the systems are locally made and feature special bracing and double-layered panels. The cabinets are available finished in selected wood veneers, oil finished and mirror imaged. Dynaudio say their speakers are best auditioned on piano, vocals and percussion.

Details available from Dynaudio (Aust.) Pty Ltd, P.O. Box 2, Hawthorn Vic. 3122.

Hitachi D1100M tape deck – the ultimate?

The Hitachi D1100M microcomputer-controlled tape deck comprises many features to substantiate Hitachi's claim that it is "the ultimate in recording operation".

The 'ATRS' automatically determines bias, gain and equalisation levels for the characteristics of any tape played. It does this with a microcomputer, which runs a 10-second, 16-sequence test on a portion of tape to determine its characteristics, then sets the deck's circuitry to match.

Complementing this system, the D1100M features the Hitachi-developed close-gap R + P combination three-head system, which is claimed to give higher performance and real-time monitoring while recording.

Other features include:

- The use of a two-motor/dual capstan mechanism for precision tape travel.
- Automatic rewind at tape end with a choice of stop or replay modes — ideal for continuous background music.
- Automatic record mute function — one touch of a button records a four-second section of blank tape.
- Metal tape compatibility.
- LED peak level indication with peak hold.
- Double Dolby system for clean, hiss-free recordings.
- Output level control.

The specifications of the D1100M are: wow and flutter — 0.038% WRMS; frequency response — normal: 20-19 000 Hz, metal: 20-21 000 Hz; signal to noise ratio – 69 dB (Dolby NR on, A-weighted, metal tape ref. 3% THD).

For further information contact Hitachi Australia Pty Ltd, 153 Keys Road, Moorabbin, Vic. 3189. (03)555-8722.

Reel-to-reel cassettes?

Looks crazy, doesn't it? But it makes sense, according to Goldring, who are releasing this 'XLR 65' cassette here, because they claim it improves performance.

The two reels inside the cassette housing sport metal cheeks and the tape spools on and off each reel with less wow and flutter, we are told. In addition, the reels make tape jamming a thing of the past.

The Goldring cassette will be available in a variety of tape formulations from top-quality manufacturers – look for the distinctive reel-to-reel cassette at your nearest tape distributor.

More information from Goldring Audio Industries, 69 Clarence St, Sydney NSW 2000. (02)290-1455.

Top quality colour camera

Hitachi are launching a compact, lightweight video colour camera, designated the VKC770, which is intended for the video enthusiast who is seeking top quality video film reproduction even under poor lighting conditions.

Weighing just 2.2 kg, the VKC770 is equipped with an f1.6 zoom lens with a focal length of 14 to 84 mm, controlled by a lever which may be fixed to either the left or right hand side of the camera — good for left-handers! A single tri-electrode pick-up tube is used which, it is claimed, produces results as good as those obtained with a three-tube colour camera.

The viewfinder is electronic, using a ⅔" diameter videcon tube. Electronic viewfinders are very useful in 'location' filming, as it can be seen immediately whether or not the scene shot is satisfactory. The sound can also be monitored simultaneously using an earpiece.

The VKC770 has a built-in omni-directional electret condenser microphone for sound recording, with provision in the form of a shoe on the top of the camera for an external boom mic.

The viewfinder is provided with a large magnifying lens, which is said to help ensure accuracy of focusing. A sensitivity control circuit automatically detects the intensity of the light; if the intensity falls, this change is immediately indicated by a viewfinder LED display, allowing the user to open up the lens aperture or switch a high-gain circuit into operation to compensate for low-light conditions. A recessed knob on the side of the camera, linked to a small adjacent VU meter, can be used to compensate for the colour temperature of the light received.

The camera is fitted with a detachable pistol grip, and an on/off switch linked to a LED indicator in the viewfinder informs the user when the recorder motor is running. LED warning lights are also used to show when battery power is too low.

Brian Dance

Videodiscs to be made in England

Thorn EMI has decided to make videodiscs and players in Britain, and it seems probable that they will come to an agreement with JVC (Japan), AEG Telefunken (West Germany) and Thomson-Brandt (France).

Following the anticipated launch of JVC's discs in Japan in October 1981, in the USA in January 1982 and in Britain by mid-1982, Thorn EMI are planning to have two disc-pressing plants in operation by the beginning of 1982. One of these will be at Cologne and the other in Britain, but Thorn will not yet reveal the location of the site they have chosen in Britain.

The four manufacturers intend that the Thorn plants will be jointly owned and will supply the European market, which uses mainly the PAL system standard. The proposals also include an extension to video cassette recorders and video cameras; AEG Telefunken will manufacture the recorders and Thomson-Brandt the cameras.

Within two years of the launching of British-made videodiscs, it is expected that Thorn EMI will commence hardware manufacture.

Philips has reputedly spent STG£75 million developing its videodisc system and had hoped to launch it in Britain early this year, but now it will not be easy even to meet an autumn launching date; in the event of an autumn launch, Philips intends to sell 10 000 players by the end of the year. One of the directors of Philips has stated that he feels a wonderful chance has been missed to establish a common standard in Europe.

The main problem at present with videodiscs is that of manufacturing an adequate number of discs of adequate quality. Discs are not so easy to manufacture as has been thought in the past and the reject rate at Philips' disc factory in Blackburn is said to be quite high.

RCA launched its videodisc system in the USA at the end of March this year, after spending some US$150 million over a period of 15 years, and it is expected that RCA equipment will be available in Europe by 1983. Indeed, RCA will be producing some five million discs and about half a million players a year by the end of 1981. RCA believe that by 1990 videodiscs will achieve a 30% to 40% penetration into US homes with colour television. By then it will be a US$7500 million per year business — which may be compared with the current $4000 million audio recording business. RCA claim they will sell some 200 000 discs by the end of 1981.

However, Thorn EMI point out that by mid-1982 the JVC system will be the only one of the three competing videodisc technologies to have been made available to users in three different continents. They stress its international strength and the fact that it is already supported by twelve major consumer electronics companies in Japan (JVC, Matsushita, Toshiba, Akai, Sharp, Yamaha, Sanyo, General, Trio, Mitsubishi, Sansui and NEC).

Brian Dance

No more noisy tapes?

The Toshiba PC-X88AD three-head cassette deck, which features both double Dolby and double ADRES systems, is claimed to make noisy tapes a thing of the past.

Toshiba's ADRES system is based on the compander method of noise reduction, with the difference that it is compatible with the cassette format and is said to render inaudible the 'breathing' effect heard in similar systems. ADRES is claimed to increase dynamic range to as much as 100 dB and improve signal-to-noise ratio by up to 30 dB.

The PC-X88AD has two sets of ADRES-encode/decode circuits, so that since it is a three-head deck, an ADRES-encoded tape can be monitored while the recording is being made.

The 'pause' button doubles as a mute recording control, and other features include four-type tape compatibility, bias fine control and recording sensitivity control with built-in oscillator, ADRES calibration controls, a memory counter, timer stand-by and a remote control facility. Recommended retail price is $380.

For further details contact Toshiba (Australia) Pty Ltd, P.O. Box 452, Lane Cove NSW 2066.

It's a better system, at a better price, and it's Sony. In Sony's new TC-K81 three head cassette tape deck, each head has its own individual casing and suspension system.

You get precise azimuth alignment,* equal record and playback head-to-tape pressure, and reduced magnetic leakage flux.

It's a unique three-head system, with two-motor, closed-loop dual capstan drive with metal tape compatibility.

The new TC-K81 also has microcomputer control and feature-touch operation, and LED Peak Programme Meter, bias and record level calibration system, and Dolby** NR.

It's an exceptional new system, at an excellent price. And it's Sony.

So in three-head technology, we're three-ways better.

Sony's 3 head system. It's 3 ways better.

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*Factory aligned.
**Dolby is a registered trademark of Dolby Laboratories.

AP 3477

Portable stereo tape deck from Sanyo

Sanyo Australia has released a novel, hands-free stereo tape player capable of high quality reproduction.

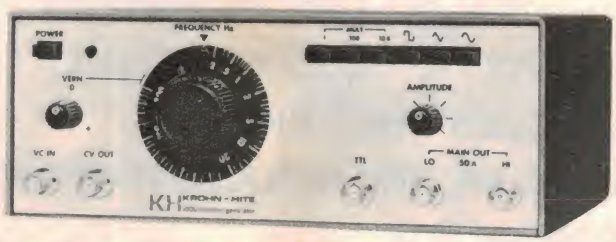
The model M 5550 has been designed as a 'go-anywhere' stereo player for people on the move who want to enjoy good quality audio performance from their tapes without annoying others.

The unit comes complete with a pair of light, comfortable-to-wear headphones, a silver leather-look carry case, belt-clip and shoulder strap.

The M 5550 features a response from 63 Hz to 10 kHz with low distortion, according to Sanyo. The player unit is super-compact, weighing only 340 g and measuring 80 mm x 132 mm x 25 mm.

Features include microphone mixing, built-in microphone, Sanyo's AMSS tape track search system, tape speed control and two headphone jacks. Other controls are fast-forward, rewind, cue and review and an external power jack. Portable power is provided by two AA-size batteries.

The M 5550 is available now at a recommended retail price of $229, including heaphones and carry case. More information from Sanyo Australia Pty Ltd, 225 Miller Street, North Sydney 2060 NSW. (02) 436-1122.



Short-circuit-proof generator

The unique Waveguard output protection circuit of the Krohn-Hite Model 1000A function generator is said to solve the problem of blown output stages, common in most unprotected generators.

Should a voltage or short circuit inadvertently be placed across the generator's output terminals — as often happens in engineering schools and universities, for example — Waveguard prevents the usual short circuit damage. It resets automatically after the external voltage or short circuit is removed.

Model 1000A provides 20 Vp-p sine, square and triangle waveforms from 0·2 Hz to 3 MHz, and provides 1500:1 frequency tuning range on each of its three multiplier bands.

For further information contact Warburton Franki Ltd, 372 Eastern Valley Way, Chatswood NSW 2067.

All-singing, all-dancing TV/monitor

Toshiba's model C531, claimed to be the smallest multi-functional television receiver in Australia, can also be used as a colour monitor, for example for playing back video cassettes or live-camera recordings.

Model C531 weighs only 3.4 kg, and measures 211 mm wide x 125 mm high x 274 mm deep. Screen size is 11.5 cm.

Other features include:

- 'Electronic Tuning', which allows pinpoint accuracy in selecting channels at greatest signal strength;
- Red and green LEDs to indicate no reception and accurate tuning respectively;
- Mains or car/boat battery power;
- Slide-type sun visor for outdoor use;
- Removable smoke filter to remove glare during outdoor viewing;
- Dual-purpose handle that adjusts the angle of the screen as well as being used to carry the set;
- Toshiba's three-year warranty on all parts, including picture tube, and labour.

For information contact Toshiba (Australia) Pty Ltd, P.O. Box 452, Lane Cove NSW 2066.

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NEW DOLBY C SYSTEM JUDGED SUPERIOR

DOLBY B•C NR

by GEOFF MATTHEWS

There has never been much doubt that compact cassette decks have been the most exciting thing to happen to hi-fi systems since hi-fi was first invented.

However there has always been a question of which noise reduction system is the best one to own — the Dolby system or one of the more recently devised American, Japanese or European noise reduction systems.

Recently though, the question seems to have been laid to rest.

In the past few months, the Dolby system has emerged the clear choice by just about every important maker of cassette decks throughout the world.

DOLBY B

Dolby B noise reduction was a key factor in launching the cassette as a viable hi-fi medium. Dolby B quickly became the standard noise reduction system amongst consumers with three major factors contributing to its success: a decisive 10 dB improvement in high frequency S/N; minimal audible side effects; and, fairly inexpensive circuitry. Since 1968 when Dolby B was introduced, the phonograph record has become much better with a movement towards direct cut disks, digital mastering and half speed cutting. Improvement in cassette heads, electronics and tapes have broken the 20 kHz barrier and cassette recorders with response to 25 kHz have become a reality. Taken together, these factors have created a demand for a noise reduction system with greater capability than Dolby B, which reduces tape hiss and other high frequency noise generated during the tape recording process by a maximum of 10 dB.

LINEAR COMPANDERS

While Dolby is the acknowledged leader in the field of noise reduction for consumer audio products, the Dolby system is hardly alone any longer. Several noise reduction systems have been devised by American, Japanese and European companies, and simple linear companders that offer greater dynamic range than Dolby B are available. However they have unfortunate side effects — audible "pumping" and "breathing". In short, they can be heard "working" and this is unacceptable. As a rule of thumb, the greater the noise reduction, the greater the possibility of audible colouration. In fact the success of Dolby B is due largely to its adroit trade-off between S/N improvement and audible side effects.

DOLBY C

Since Dolby Laboratories announced and demonstrated their newest noise reduction technology which they called Dolby C, just about every important maker of cassette decks has introduced one or more models which incorporates the newest of Dolby's consumer type noise reduction systems.

The new Dolby C noise reduction system offers up to 20 dB of noise reduction at high frequencies and begins operating at a lower frequency point in the spectrum than did Dolby B. However, Dolby C is not "across the board" circuitry that will be used by manufacturers in all of their cassette deck models from most expensive to least costly. Dolby C, while usable by Dolby licensees without having to pay any additional royalty, costs approximately 2½ times as much to incorporate into a deck than does Dolby B. Furthermore, as some manufacturers are finding out, the new noise reduction system only works best when it is used in high quality decks which have reasonably uniform frequency response capabilities to begin with.

INCREASED DYNAMIC RANGE

Noise reduction and increased dynamic range are closely related. When the noise threshold decreases, greater dynamic range can be stored by a music storage medium such as disk or tape. Dolby has always stressed the noise reduction qualities of their systems but points out that with Dolby B, they can approach dynamic range capabilities of 80 dB on a properly designed cassette deck. Dolby C affords substantially greater dynamic range without increased colouration.

COMPATIBILITY

Dolby suggests that new cassette recordings made using the Dolby C process will sound reasonably good when played back on decks which are equipped only with Dolby B decoding circuitry. Whilst shunning the word "compatibility", they have maintained that Dolby C recordings played back with no decoding whatever will be "listenable" to non-critical ears.

Nakamichi's NR-100 Dolby C Noise Reduction Processor

On the other hand, makers of other noise reduction systems make no such claims admitting that a recording made using one of them cannot be played back properly using equipment that contains a decoder of a competing system. In that sense, none of the systems are compatible with either their competing systems or with play back systems not equipped with any noise reduction system.

DOLBY RANKED NUMBER ONE

In offering 20 dB of noise reduction, substantially greater dynamic range without increased colouration and "compatibility", Dolby has taken another major step forward in improving the compact cassette as a hi-fi medium. And its choice by major cassette deck manufacturers clearly indicates that the experts believe that the Dolby system offers better technology, better features and better hi-fi.

NAKAMICHI Z SERIES

One after another cassette recordings "insurmountable" barriers have fallen before Nakamichi innovation. Almost a decade ago, Nakamichi accomplished the "impossible" and developed a three head cassette deck. Continuing research extended cassette response to 20 kHz, to 22 kHz and now to 25 kHz. Today there are Nakamichi cassette recorders whose band width exceeds that of professional digital recording equipment.

It has been said that the current range of Nakamichi cassette decks represents the ultimate expression of the Nakamichi philosophy — "excellence in the fine art of recorded sound". But Nakamichi does not stand still. The second generation — Nakamichi Z Series — further pursues the philosophy.

DOLBY B-C TYPE NOISE REDUCTION

The thorn in the side of cassette recordings has always been noise — the hiss that creeps in during quiet passages. Dolby B reduces this hiss by up to 10 dB with virtually no audible side effects but some hiss does remain.

In 1980, Dolby announced a new C-type system that is almost twice as effective in reducing high frequency noise as Dolby B while producing hardly any audible side effects. But to achieve full potential, Dolby C demands a high level of precision from the tape recorder with which it is used. Nakamichi believes that Dolby C will become the standard noise reduction system for the 80's and so it is incorporated in all Nakamichi Z series cassette decks.

WIDE RANGE PEAK LEVEL METERS

Nakamichi recorders have been known for superior metering. In keeping with the greatly improved total dynamic range of the Z series, accurate peak level indication is essential. New peak responding electronic LED or FL displays with a meter range extending from −40 dB to 10 dB above "O" — sufficiently wide to give accurate indications on all musical signals — are incorporated in all Nakamichi Z Series decks.

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482Z Dolby B-C type NR electronic LED metering, headphone output level control, bias tune control, discrete 3-head technology, off-tape monitoring.

582Z Dolby B-C type NR electronic LED metering, bias and record calibration controls, built in twin-tone oscillator, discrete 3-head technology, off-tape monitoring.

682ZX Dolby B-C type NR auto azimuth alignment and auto record level calibration, adjustable bias and calibration tones, 50 dB high resolution FL metering, 9 programme RAMM, discrete 3-head technology with 22 kHz response, off-tape monitoring, removable rack mount. ▼

Hear the new Nakamichi Z series at your nearest authorised dealer or for further information contact Convoy International,
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Nakamichi

A view of one corner of the Chicago Consumer Electronics Show

Video battle in full swing while audio regroups

Dennis Lingane

The videodisc is definitely on, but who will win top place in the market is anybody's guess. The movie moguls are generally placing each-way bets so software may no longer be the deciding factor. Meanwhile, hi-fi manufacturers and marketers are licking their wounds from the past few years' slump and rallying for an attack on the radiogram market. This year's Chicago C.E. Show clarified the hazy picture revealed last year.

AFTER HAMMERING back and forth to press conferences on the videodisc at the Chicago Electronics Show in June, I can say with some confidence that the videodisc will be a goer.

All those doubting Thomases who say it won't because it can't record are not taking into consideration two facts: the disc gives better sound, and it may be expedient for the movie moguls to make sure the disc *does* succeed.

Three-way battle

Traditionally software companies stand aloof from the electronic ego battles. They prefer to wait until the dust settles and then when a format surfaces as supreme, will issue software for it. This has usually meant the demise of a good idea, as with the four-channel sound debacle, for example.

However, although at this year's electronics show it became obvious that the three-way battle would not cease for the lucrative videodisc market between the Japanese (VHD), Americans (RCA) and the Europeans (Philips/Pioneer's laser system), the movie companies were extremely keen to get into the action.

Why, one wonders, should they break a life-long tradition of sitting on the fence? To get the answer one has to turn to the *cassette* video market.

Piracy

Three years ago the movie companies didn't want a bar of the video age. To them it meant huge losses as their movies were taken off air and then sold underground. The situation got so bad that brand new movies not even released to cinemas were turning up on bootleg video cassettes.

In a long drawn-out court case Sony was sued by Disney and MCA Universal, and in what was considered a world copyright exercise the industry looked on. Had the movie companies won, it would have set all sorts of precedents — why shouldn't Xerox and all the copy machine manufacturers not

have to pay similar royalties to authors and magazine publishers?

Fortunately the judge ruled for Sony. The movie mogul immediately appealed, but that is seen only as a stop-gap gesture. Meanwhile they decided if you can't beat it then join it. Twentieth Century Fox bought out Magnetic Video and started releasing movies on cassette before even the cable TV people got them.

Now every major movie company is in the market, but they are continuously plagued by bootlegging, piracy, and illegal renting. Paramount has tried to get round the problem by selling a tape to a dealer at a high cost and then letting him do what he wants with it. Disney tried the same exercise but recently had to lower its prices because it wasn't getting the support. Magnetic Video has caught dealers renting out Mag Video films three or four times and then shrink-wrapping the tape in clear plastic and selling it as new.

All sorts of crazy ideas are being put forward to solve this piracy and bootlegging problem. One company has designed a cassette that won't rewind, so when you rent it you only get to see it once and then you have to take it back to the dealer.

Superscope has produced a Beta video recorder that is inaccessible. The consumer takes home the complete machine, no larger than an attache case, with the tape safely locked inside. When he has played the tape through his TV he can neither rewind the tape nor remove it. He has to take the complete machine back to the dealer.

In fact, however, none of this stops piracy. In both these cases a pirate can, instead of plugging the machine into a TV, plug it into another video recorder and take a dub of the movie.

So for the movie moguls there appears no way out of the dilemma. No way, that is, except for the popularisation of the videodisc.

Disc vs tape

A disc, which gives a better quality picture and far better sound (stereo even), costs the same as a blank cassette (give or take a few dollars).

There is no point dubbing a poor-quality version of a movie onto a blank tape when you can buy a superb-quality version on disc for the same price. One might argue that it is worthwhile if you want to see the film only once and then erase it. But the general opinion is that people will want to collect movie films as they do books and records, and that the argument that you listen to a record dozens of times but only ever want to see a film once doesn't hold water.

How many records in your collection do you play regularly? Probably about a dozen. And how many times do you re-read those books that fill your shelves? Twice in a lifetime maybe. It is the *ownership* of books and records that keeps these industries ticking over, and the movie industry thinks that exploitation of this 'collection' idea by use of the videodisc will be its salvation from bootleggers and pirates.

Software and systems

At the Chicago Electronics Show all movie companies joined hands with one or other of the three videodisc formats. All agreed too that should any of the two they were not joining with at that time become popular, they would also supply software for them.

"We are in the business of making money," said an MGM spokesman, summing up the feelings of all other movie companies.

At the show MGM and CBS announced their support for RCA's CED system, while Columbia, Paramount, Mag Video, and MCA all said they would supply titles for the laservision system. Even VHD got a guernsey with the surprise announcement from MCA that it would supply a range of titles to VHD Program Inc, who will be marketing software for the JVC disc system ▶

Videodisc solves the software piracy problems, but which system will win in the marketplace is unclear.

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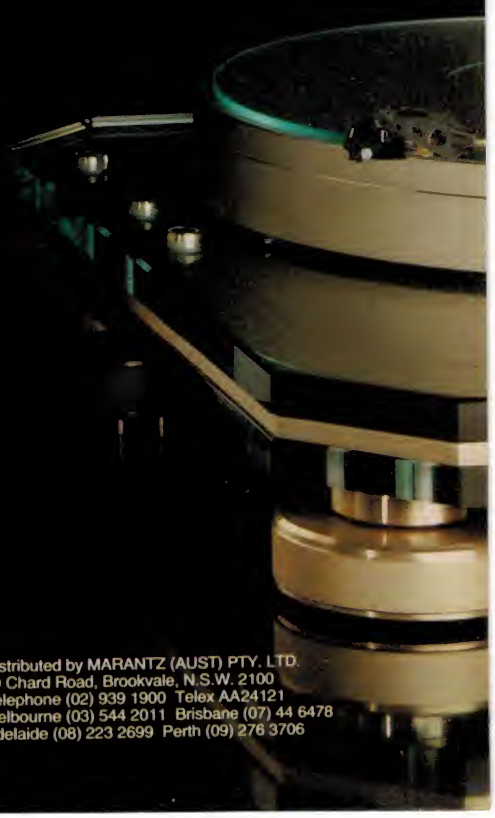

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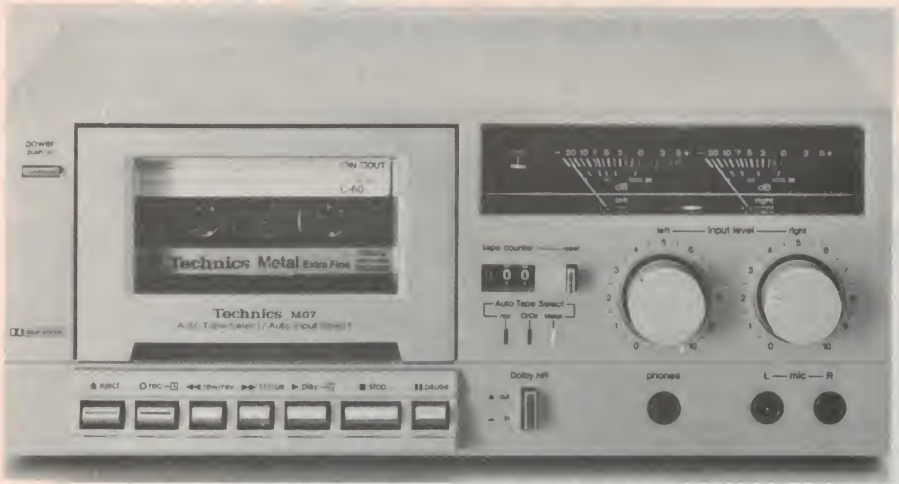

Low-cost cassette decks now offer excellent performance, much better than that obtained a year or so ago, plus features that were never previously offered. This is the MO7, a new release from Technics. A 'mini-series' deck, it will deliver a frequency response of 20 Hz to 18 kHz on chrome and metal tape and features a system that 'detects' the tape in use and then adjusts the bias and equalisation to suit.

players. MCA is a joint developer in the laservision system with Philips, so the announcement raised a few eyebrows. But even an opposition format is better than the problems piracy and bootlegging are giving the movie industry, so when VHD launches in January 1982 it will have 75 titles, says Lou Delmonica, Vice President of VHD Programs.

And there we have the guaranteed future success of the videodisc. The movie companies want it to save them from the problems of piracy, and my bet is that as the disc becomes more popular the movie companies will issue all the new movies on disc and hold back on cassette to encourage the public to buy discs. In this they won't be doing either themselves or the public that much of an injustice. In time the consumer will have paid for his videodisc player with the cash he saves in buying discs, as a disc is between half and a third of the price of a pre-recorded cassette.

The disc player will therefore be part and parcel of the home entertainment centre. In fact, the trend in the US is for those who buy a video cassette recorder to buy a videodisc player next. The VCR will basically become a time shift for missed TV programmes, and a photographic aid.

Audio scene

Although the audio industry has in general suffered rather a slump recently, on the positive side the electronics manufacturers have done an amazing job of keeping prices down and giving us better audio products.

This year we will see cassette decks available from around $160 with solenoid switching, and for around $300 we will be able to buy cassette decks that only a few years ago cost almost double. Amplifiers are now offering more watts to the dollar than ever, and the sophisticated circuitry that is hidden under those metal facias is more sophisticated than ever. Speakers are becoming more efficient by the month without sacrificing the sound. Even the most lowly hi-fi component is as good as the top hi-fi component of only a few years ago; in every direction the industry is leaning over backwards to keep prices down on one hand but build better gear on the other.

Microprocessors are finding their way into everything, including turntables which now operate vertically as well as on their heads, thanks to the development of microprocessor-run servo systems for the control of tone arms.

The ever-present 'chip' has proved to be the greatest friend the Japanese have had since they discovered mass production. Just when overheads and increasing salaries were forcing the Japanese to move production to cheaper climes, like Taiwan and Singapore, along came large scale integration and the consequent 'compression' of circuitry from thousands of discrete components to a few chips and little else.

A good idea doesn't care who it belongs to, and although the US may have invented mass production and the integrated circuit, it is the Japanese who are really making both work for them.

New phase

The audio industry is about to enter a very interesting phase. Whether the forthcoming year will see hi-fi survive or the whole of the industry switch to radiogram marketing techniques is the big question mark.

In Europe and America Japanese companies are in the main pursuing a 'systems' philosophy. Hi-fi dealers have to decide whether they will accept Japanese speakers and Japanese electronics in a package or get nothing.

The Japanese giants argue that we have saturated the technically aware buying market and this is the reason for hi-fi sales slowing down. Now they say we have to turn to the 'radiogram' mum-and-dad market to keep factories around the world operating. ▶

Can cassette decks get any smaller? Yes – if they play the new microcassettes! This deck, the RD-XM1 from Sanyo, measures half the size of the mini-decks that play standard tapes. Amazingly, it has all the features of its bigger brothers, and tape performance is claimed to be only marginally behind. Sanyo are undecided on an Australian release.

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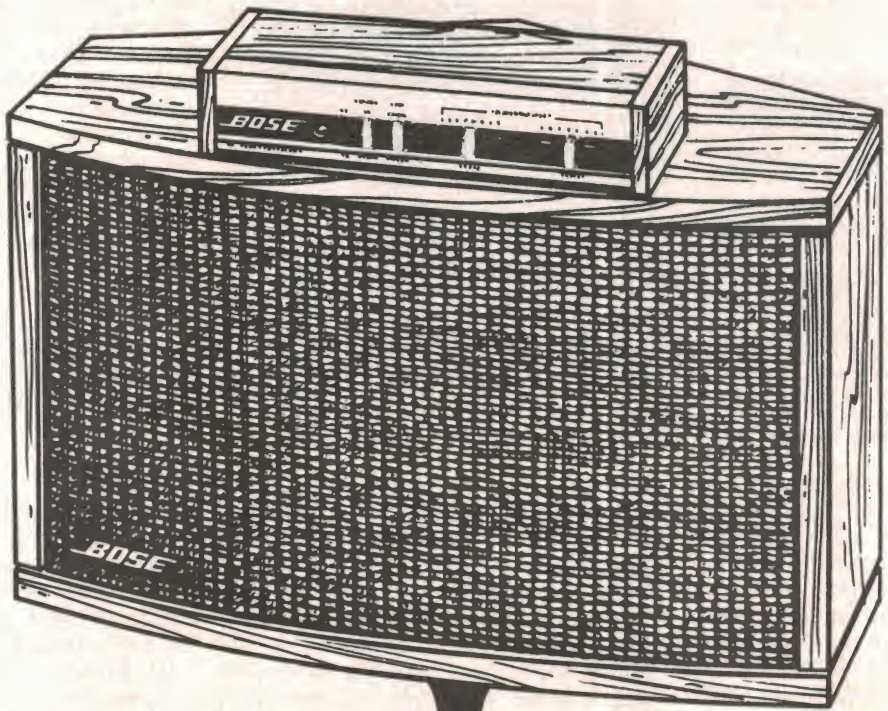

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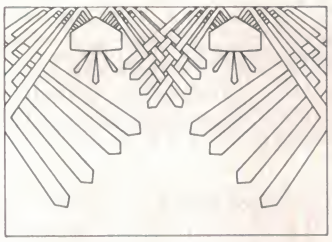

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However, while they adopt this attitude on the one hand, they are still producing more and more technology, and continue to lock horns with each other about whose new technology is better. The result is that those who would like to be component buyers will become so confused about linear feed forward, linear feed back, Sigma drive, clean drive and super drive that they are likely to give up in disgust and buy a basic radiogram (i.e: a 'three-in-one' or 'sound centre') type of hi-fi system anyway.

And if there isn't enough confusion in the marketplace with these new amplifier circuits, the major manufacturers have now divided on cassette deck development!

Less noise

Noise reduction systems like ANRS, Super D, and ADRES have been battling away for a year or so. Now into the arena comes Dolby C, High-Com and dbx — not only as an add-on unit but as a built-in feature.

So the baffled consumer, reeling with all this new technology, will be subjected to endless arguments about which is better. Again, he is probably going to opt for the 'radiogram' type of sound system rather than take a degree in electronics to sort it out.

Even if the consumer does come to terms with these new noise supression and dynamic range enhancing systems there is another problem: none is compatible with his car sound system. And what is the most popular use for a cassette deck in a hi-fi system? To make ▶

Digital disc players are slowly making their presence felt, but the rest of your system will have to be 'digital capable'.

SV-P100

Digital tape decks made their first commercial appearance last year. The Technics P100 (not available here yet) uses a standard video cassette.

cassettes for a car or portable radio cassette system.

The industry could have helped the situation by making available car component High-Com, dbx, etc, decoders for the car. But that would be too constructive (so far Rockford-Fosgate are the only ones to do it — they offer dbx decoding in their new range of amps/preamps). Why change a life-long record of confusing the public — even if the industry is in its most critical situation for the last ten years?

Digital

While the Japanese are producing new technology that produces staggering results in laboratory conditions (although most of these advances are inaudible when it comes to a practical situation), the European and US manufacturers are preparing for the launch of the digital disc. They see this as the big opportunity for the audio industry, but to welcome it they need digital-capable electronics and digital-proof speakers.

The amplifiers need to have plenty of headroom to cope with the 100 dB dynamic range, so the next year or so will see a trend towards more powerful amplifiers. I like the NAD idea of making a 40 watts per channel stereo integrated amplifier that can be switched to a 160 watt mono amplifier. A mono 160 watt power amp module will be available shortly and this can be added to the original stereo unit, so that the NAD buyer gets a 160 watts per channel amplifier system that can cope with a digital disc dynamic range.

Yamaha has adopted the Carver type of circuitry for its new X-power amplifiers. This offers high peak power without the need for large transformers, cutting back on heat and size problems.

Active speakers

The development in amplifiers will lead next year to popularisation of the active speaker concept. Originally launched by Philips around ten years ago, it has not caught on yet, probably because the public like to have their amplifiers up front where friends and neighbours can see them. However, during long discussions in Japan towards the end of last year, most manufacturers said that the advent of digital audio would mean a swing to active speakers with the power amplifiers built into the base of the speaker.

Speakers will also need to be able to cope with high thermal situations as they are driven to their limit by the digital sound. Some manufacturers are introducing protection circuits that will either cut the power to the speaker when it looks as if it is going into an overload situation, or reduce the sound by several dB until the peak passes.

All in all, the industry is going through a big shake-out. People in Europe are forecasting that many of the well-known Japanese companies will not survive in the forthcoming rationalisation of the audio industry, and maintain that this move to radiogram-type marketing is a panic move to save the day.

The next twelve months will tell. ●

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Louis Challis

THE RELEASE of the B&W DM10 loudspeakers is a major departure in philosophy for a firm which has tended to stick by sealed box enclosure techniques in virtually the complete range of products previously manufactured by them. The DM10 is B&W's first serious attempt to provide an economy speaker with characteristics similar to their better known speakers.

B&W decided that both their home market as well as the export market needed an economy speaker with a genuine walnut wood veneer cabinet and not a plastic finish like many competing speakers. More importantly, it should offer a performance of which they would be in no way ashamed, by comparison with either other speakers in their existing range or the other quality speakers with which they knew they would be competing.

B&W decided that if they were to achieve a reasonable acoustical performance in the range 50-120 Hz they would have to discard their previous practice, based on the use of sealed enclosures, and change their philosophy to make use of a vented enclosure. In order to contain costs whilst still covering the 2.5 decades in frequency they also decided on a two-way system. This would have a 200 mm low frequency driver covering the frequency region from 60 Hz to 2.5 kHz and a 26 mm diameter tweeter covering the frequency region 2.5 kHz to 20 kHz.

The low frequency driver is a new design featuring a rigid cast alloy chassis and speaker basket. This uses a light, rigid, multi-stranded fibre-based speaker diaphragm to cope with the high excursion that results from the use of a vented design. The design of this speaker has been truly optimised by B&W's laser interferometry technique in order to maintain good piston characteristics over the wide frequency spectrum from 50 Hz to 2.5 kHz.

By contrast the tweeter was a well-proven existing design. This employs an epoxy bonded voice coil and a damped multi-filament polyester woven dome. It offers excellent dispersion, high power handling capacity, and as we were able to show, excellent transient response.

LOUDSPEAKER DATA SHEET

MEASURED PERFORMANCE OF B & W DM10
SERIAL NO. 1519

FREQUENCY RESPONSE: 70Hz - 20kHz

CROSSOVER FREQUENCIES: 2500Hz

SENSITIVITY:
(for 90dB average at 2m) 6.9 VRMS = 6 Watts (nominal into 8)

HARMONIC DISTORTION:
(for 90dB) at 2m)

	(85dB) 100Hz	(90dB) 100Hz	1kHz	6.3kHz
2nd	-29.5	-19	-64.1	-43.9dB
3rd	-35.2	-31.6	-52.3	-43.9dB
4tn	-55.8	-36.6	-70.3	-64.6dB
5th	-50.2	-47.5	-68.4	-dB
T.H.D.	3.8%	11.6%	0.26%	0.9%

INPUT IMPEDANCE:

100Hz	9.0	
1kHz	26.0	
6.3kHz	6.25	
Minimum at 7kHz	6.2	

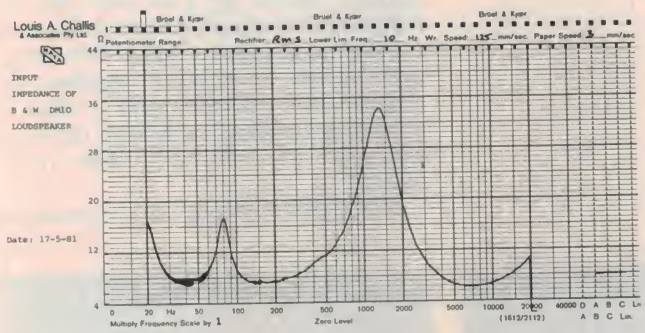
The crossover design makes use of the existing techniques that B&W have developed to an advanced level over the past five years and incorporates third-order Butterworth configurations to maximise the attenuation in the adjacent speaker's pass band. These crossover filters achieve better than 18 dB per octave attenuation rate in the octave immediately outside the pass band and ensure that both the low frequency woofer and the high frequency tweeter work well together without significant interaction.

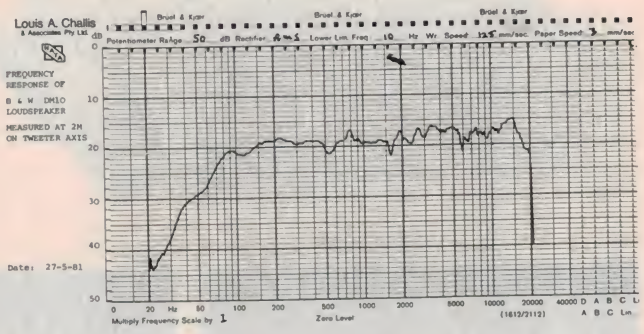
The front of the enclosure is finished neatly with a very open weave black artificial fibre speaker cloth, and the back contains a plastic well with two screwed terminals. The immediate image is of a speaker costing more than the moderate $399 recommended retail.

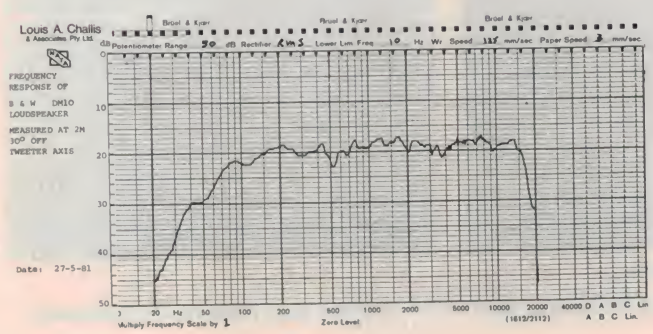
On test

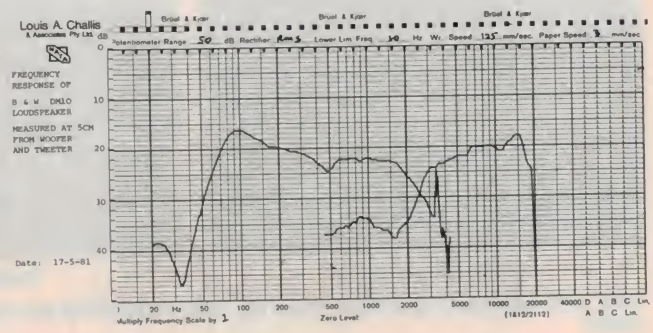
When I learned that this was B&W's cheapest speaker, I had visions of a nasty non-linear performance before I opened up the packing box. The objective testing just did not support these qualms. The frequency response on axis shows that over the frequency region 75 Hz to 20 kHz the response is better than ±4 dB, and it exhibits a smoothness of response which one would only expect from a very expensive system. At 30° off axis the response is still exemplary, only dropping beyond the specified limit above 17 kHz. This sort of performance is what one would expect from a very well-designed system.

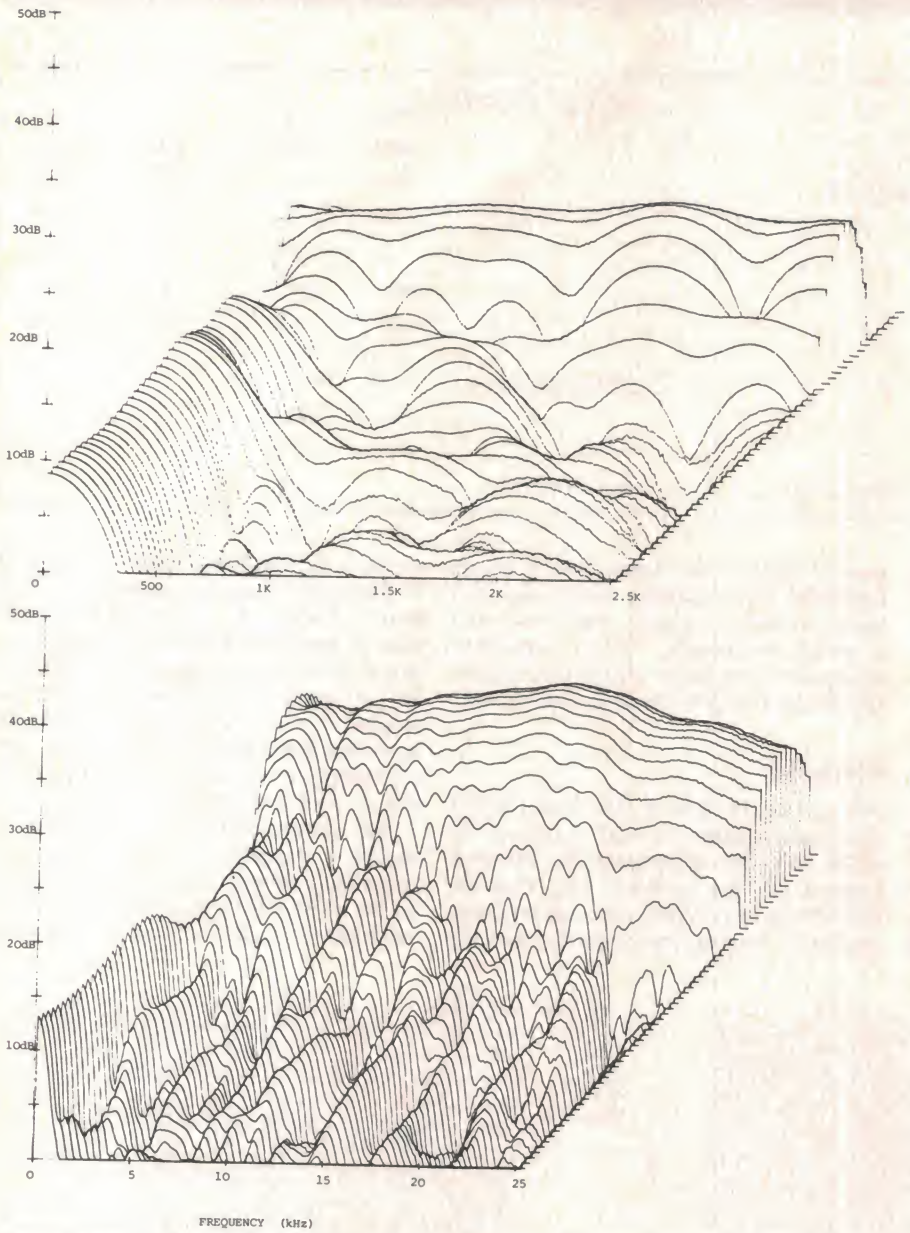
The phase response is, in many respects, superior to the frequency response, and over the frequency region 70 Hz to 20 kHz there is less than a 180° total phase shift. This is very smooth ▶











and can only be described as a linear phase response.

The impedance curve exhibits some unusual peaks and dips, with the fundamental frequency resonance occurring at 80 Hz and resulting in a 17 ohm impedance, whilst at 1.3 kHz there is a 34 ohm impedance. The lowest impedance occurs in the region 6 kHz to 10 kHz and is 6 ohms. This value would still allow this speaker system to be paralleled with another speaker system should this be desired.

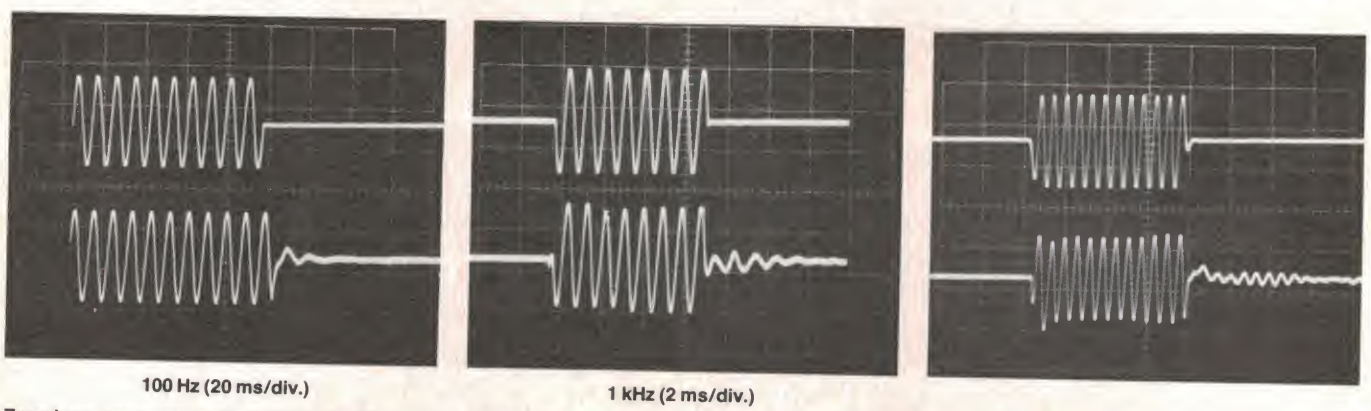
The computer-derived decay response spectra show that with the exception of a rolling resonance in the 2 kHz region the residual resonances are well controlled, although there are significant resonances in the frequency regions of 2 kHz, 5 kHz, 7 kHz and 14 kHz. Obviously, with such detectable resonances, one would expect some sound colouration, even though it is not pronounced.

With the exception of high-level signals at 100 Hz and lower frequencies the distortion characteristics of the system are extremely low. These are generally adequate for the low frequency driver and most particularly for the tweeter, which is able to handle high-level signals without significant colouration or distortion.

Subjectively

The subjective assessment of this speaker shows up how well the designers have achieved their basic aim, namely to achieve a good wide-range performance in a small speaker enclosure and still maintain a class of performance comparable with the more expensive brothers and sisters in the family.

This DM10 system soon showed me



100 Hz (20 ms/div.)

1 kHz (2 ms/div.)

Tone burst response of B&W DM10 (Serial No. 1519), for 90 dB steady state SPL at 2 m on axis. Upper trace is electrical input, lower trace is loudspeaker output.

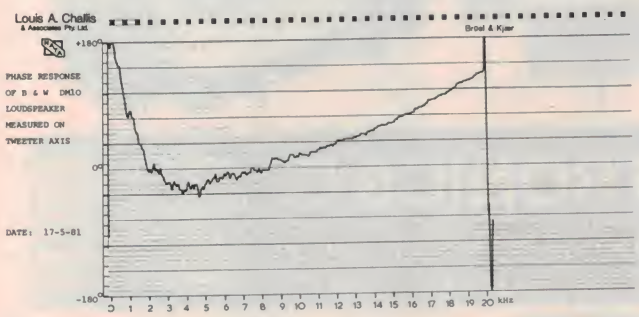
that it is really well designed for classical music and when restricted to that role provides a performance which is unquestionably excellent. When subjected to rock and heavy beat music the speaker is just not able to perform as well as one might like at levels above 95 dB at 1 metre. Nevertheless it performs moderately well, without gross speaker break-up or excessive distortion.

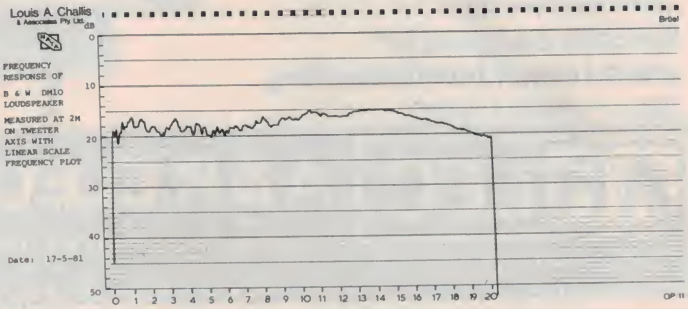
When playing tracks like the "Free to Feel" segment of Kerry Biddell's record "Compared to What" (EMI SS301), which is the first Australian digital record, the DM10 really shines and provides the type of performance that most audiophiles are seeking in a small speaker system, without compromising any of the quality.

The DM10 is a surprisingly good economical little speaker system. It offers excellent stereo imaging, clean and generally uncoloured sound, excellent transient response, and all within a cabinet with only 28 litres volume. At $399 a pair it can only be regarded as an excellent buy. ●

B&W DM10 LOUDSPEAKER SYSTEM

Dimensions:	*Height 485 mm, width 250 mm, depth 235 mm*
Weight:	*6.6 kg*
Manufactured in:	*UK by B&W Loudspeakers Limited*
Distributors:	*Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. Ph. (02)358-2088*
Price:	*$399 pair*





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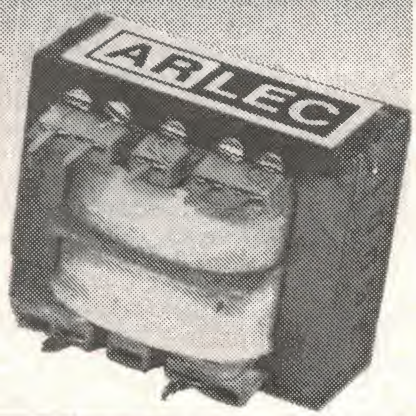

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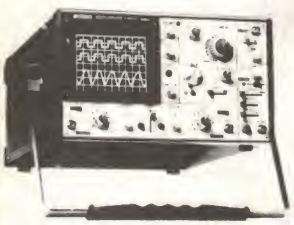

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HITACHI

Where quality comes first.

Audio Technica ATH8 stereo headphones

Long live the headphone! — particularly when you can get 'phones as good as this pair. Louis says these 'phones "... offer a rare example of ... the sort of quality now regarded as the norm from the best loudspeakers ...".

Louis Challis

WITH ALL the emphasis in the media lately on loudspeakers, one would be forgiven for thinking that headphones are a dying field. Factually, nothing could be further from the truth. Over the last 18 months headphones have experienced an upsurge in sales which is quite remarkable. Much of this growth is the direct result of the Sony Walkman and its multiple imitators, which have created a new market for mobile personal listening to pre-recorded cassette tapes and more recently to miniature FM stereo receivers.

This increased awareness of the intimate listening pleasure that only headphones can create has generated and improved sales for the better headphones, particularly where they offer special attributes in terms of either improved frequency response, lower distortion, better transient performance or improved comfort.

Audio Technica are one of many manufacturers who came into the headphone field as an accidental diversification.

When I visited their three plants last year the chief engineer, Mr. Nemoto, explained how they had an in-house requirement for headphones to be used in monitoring the performance of their magnetic cartridges at the end of the production line. This in-house requirement, claimed to be necessitated by dissatisfaction with other available headphones, spawned a range of headphones whose performance has tended to improve with each new model.

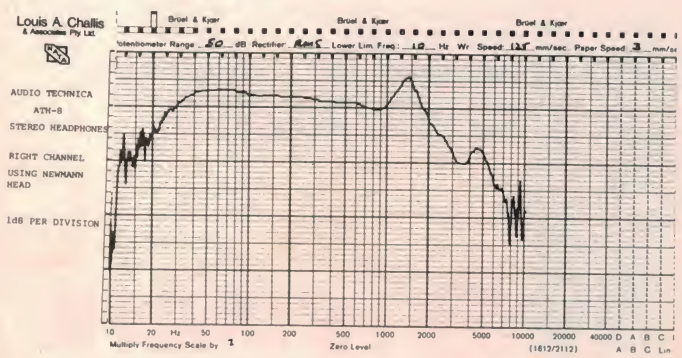
Heart of the matter

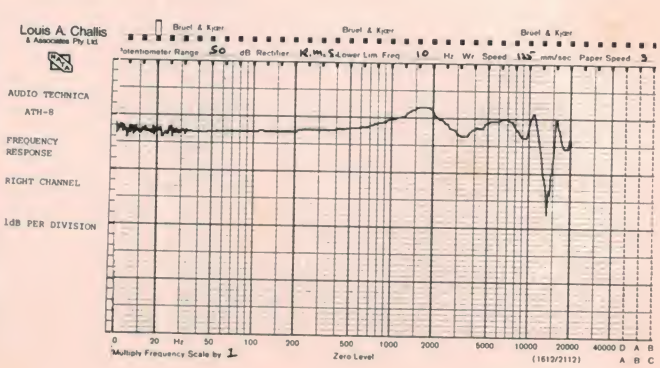
The heart of each set of Audio Technica second generation headphones is an exquisitely made two-micron-thick electret capsule manufactured in the laminar-flow clean work area at the Machida factory. These diaphragms are lightweight, extremely sensitive elements, with a special configuration designed to provide extremely flat frequency response. I watched a number of sets of headphones being subjected to frequency linearity testing on artificial ears at the factory and was impressed by the extent to which their quality control is strictly enforced.

All the parts for the headphones are now manufactured in company plants and Mr. Matsushita, the founder of the firm, has devoted his resources and attention to manufacturing all the bits and pieces required.

The ATH8

The headphones are neatly fabricated from black plastic with a spring steel headband lightened in weight through the incorporation of nine circular holes.





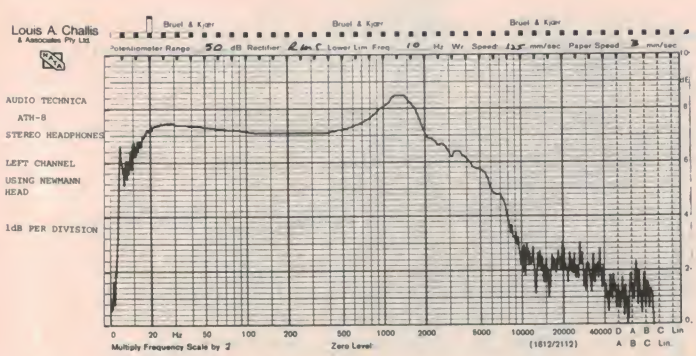
This simultaneously reduces the lateral pressure of the yoke on the ears and provides a positive improvement in appearance.

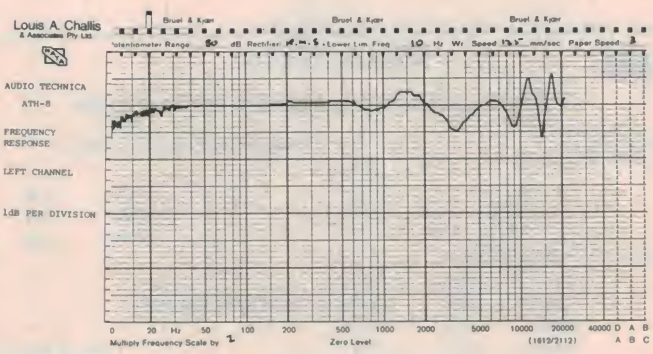
Underneath the steel headband an artificial leatherette cover is attached to provide protection for your head and this, like the yoke, is terminated on both sides in spring-loaded adjustable clamps that allow the headphones to be repositioned or enlarged to suit the size of your head.

Each headphone is encapsulated in a light plastic moulding with a black anodised wire mesh on the outside and a rather thin, brown, moulded pad on the inside. Although the pads appear thin they are generally comfortable and after placing them over the ears one is immediately aware of the low attenuation they provide and the veritable 'open-air' sensation. One design feature is the particularly low measured transmission loss.

The headphones are connected by a four-wire parallel ribbon cable with a large plug, which is inserted into the stereophone adaptor. This adaptor has two sockets so that two pairs of headphones may be used at the same time by two different people listening to the same programme.

The adaptor unit contains impedance-matching transformers to provide the voltage step-up from the low voltage output from an amplifier, which is connected by means of a set of spring-loaded terminals and wires to the amplifier. A second set of terminals is provided on the box through which the loudspeakers are connected, and a switch is provided on the front panel for changing over from headphones to main loudspeakers. ▶





The box contains two printed circuit cards with level detector circuits for operating two six-segment LED displays. The highest level in each of these displays indicates excessive drive and thereby warns the user to reduce the power input.

One other control is provided in the form of a high level/low level switch so that the headphone output range may be adjusted up or down by six decibels.

On test

We carried out our objective testing of the headphones on an artificial ear Bruel & Kjaer type 4153, which is still the industry standard for this type of test.

With each headphone clamped on the test plate and a pressure corresponding to a separation of 200 mm on the head, the frequency response is 10 Hz to 20 kHz — 6 dB. The main part of the response extending to 10 kHz is remarkably smooth, whilst the peaks and bumps in the 10 to 20 kHz region are partially attributable to the artificial ear itself.

The phase response of the headphones is also remarkably smooth and shows that these headphones can provide better coherence and cleaner sound than most conventional dynamic units as well as many other electrostatic headphones.

At the time of running these tests I was evaluating a Neumann artificial head so I tested the headphones on this as well. The results of this test are interesting but not spectacular, and provide correlation data for evaluating the Neumann system.

Out of interest I attempted to run a decay response spectrum on the headphones (the first time we have done so), and although the results are incomplete, it is clear that there are significant decay resonances in 1.5, 7, 10, 18 and 22 kHz regions. These resonances give rise to some of the 'presence' of these headphones, which shows up on transients. It should be noted that I would expect similar resonances in other headphones, not just in these.

The distortion at 90 dB SPL is particularly low, being typically less than 0.5%, and it only really starts to rise at levels exceeding 110 dB, where 2% distortion occurs.

We tested the air attenuation of these headphones at 100 Hz, 1 kHz and 6.3 kHz and measured negligible insertion loss, so they should provide a true 'open ear' sensation provided the existing levels are kept down to below 90 decibels.

To the ears

The subjective testing of these headphones was a sheer delight. I have always enjoyed the quality of sound produced by lightweight electret headphones and have one vintage pair circa 1973 at home which I seldom get to hear. (My family regard such exploits as anti-social, but when the listening constitutes part of a reviewing role even they don't complain.)

The Audio Technica headphones offer a rare example of how one can obtain the sort of quality now regarded as the norm from the best loudspeakers without spending the sort of money necessary for those.

The whole audible spectrum from these headphones fills your aural world with a presence which has to be heard to be appreciated. I played many records and tapes, including some exciting new ones like EMI's first Australian Digital Record "Compared to What" (SS301) featuring Kerrie Biddell, designed for playing at 45 rpm. This record is an Australian break with tradition and augurs well for what we are likely to see (and hear) over the next few years. This record and others heard through the headphones convinced me of EMI's improved capabilities as much as it convinced me of the capabilities of the headphones themselves.

At a recommended retail selling price of $346.74 the Audio Technica ATH8s are particularly expensive headphones. When compared to the price of loudspeakers capable of achieving similar performance, however, they offer a standard of fidelity, a total frequency response and other acoustical attributes to which many audiophiles have long aspired but till now been unable to afford. ●

AUDIO TECHNICA ATH8
STEREO HEADPHONES

Dimensions:	*Headphones (N.A.); Adaptor height 140 mm, width 60 mm, depth: 220 mm.*
Weight:	*275 gm (headphones) 1820 gm (adaptor)*
Price:	*$346.74 rrp.*
Manufactured by:	*Audio Technica, Japan*
Distributed by:	*Maurice Chapman Pty Ltd, 44 Dickson Ave, Artarmon NSW 2064. (02)438-3111.*

HEADPHONES DATA SHEET

MEASURED PERFORMANCE OF AUDIO TECHNICA ATH -8 AND ADAPTOR

SENSITIVITY:
(for 90dB SPL @ 1kHz)

	Left	Right
"High"	1.6V	0.82V
"Low"	3.2V	1.6V

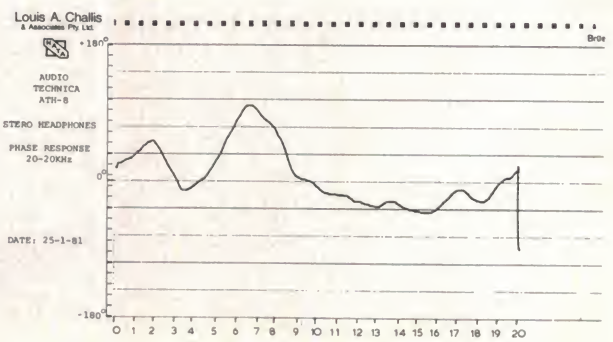
TOTAL HARMONIC DISTORTION:

	90dB	110dB
100Hz	0.55%	0.95%
1kHz	0.15%	0.86%
6.3kHz	0.22%	2.0%

REDUCTION OF EXTERNAL NOISE:

100Hz	0.1dB
1kHz	0.1dB
6.3kHz	0.2dB

FREQUENCY RESPONSE:
10Hz - 20kHz ± 6dB



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COMPUTERS

SELL: Digital PDP-8E backplane, can be used as buss-board for LSI-11 or other micros. Worth $400, sell $200, or best offer. Brisbane, David, phone (075)86-6240.

WANTED: Servicing information of any type for Olivetti DE525 minicomputer. Phone Craig (02)569-7670.

PERTEC disk drive and power supply. Suit System-80, TRS-80 or Sorcerer computers. Sell $320 ono. Phone (02)451-6113.

APPLE II plus 48K RAM, colour monitor, disk drive and controller and software, $3000 ono. Phone Terry (03)873-3820, after 7pm.

FOR SALE: Central Data S-100 64K RAM board with 48K fitted. 2 MHz version with manual, $250. Phone (02)642-9243, bh.

SORCERER Development ROM-PAC, manual, as new, $85. Phone David (02)27-2222 bh, Five Dock.

WANTED: First two issues of Compute Magazine. Mike Painter, 12 Summerleas Rd, Fern Tree, Tas 7101.

FOR SALE: 2 x Siemens 100 teleprinters, 1 x model 15 page printer modified for TTL ($95, $85, $65 resp., will neg on price). (046)25-4308.

SYSTEM 80 L2/16K, latest one, full documentation, all books & cassettes (games & blanks) included. Only 3 months old, $680 ono. Mark Gosbee (02)88-4468.

CHESS CHALLENGER, comes with pieces, transformer and instruction booklet. Excellent condition. Must sell, $135 or best offer. Ring Michael (02)84-5020 after 4 p.m. 50 Malton Rd, Beecroft 2119.

PRINTER: 7 x 5 dot matrix PR40. Upper case with parallel interface. 40 characters/line. $165.00. Geoff (02)86-4785.

PRINTER, suit microcomputer application, used with TRS80 at present. 80, 40 or 20 characters per inch with reverse printout and other features. 9 x 7 dot matrix. $360 ono. Phone (02)30-8261 a.h.

SORCERER development pac and manual, as new, hardly used, $120. Phone (03)90-9868.

FOR SALE: Sinclair ZX80, 8K ROM, old 4K ROM, 4K RAM, 9 Vdc PS, 2 books, 2 manuals, over $400 worth, $300. Phone Grant (03)438-1974 a.h.

SELL: ZX-80 invaders cassette — unable to work in new ROM, $15. Lutheran School, Waikerie, SA 5330.

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SELL: Watanabe X-Y/X-T recorder, full A3 size with roll chart adaptor, model WX-411R. Used once, $1800 ono. Phone Reg, Yowie Bay 524-5918 a.h., 525-2811, ext. 281 b.h.

CHESS COMPUTER: Sensory chess challenger! Brand new with transformer, instructions, pieces, $190 ono. Charles Loeven, 44 The Corso, Surfers Paradise Qld 4217. (075)38-2135.

WANTED: Sorcerer and bits as backup for present equipment. Phone J. Silver (042)61-3066.

SELL: Dream 6800 with PSU, full documentation, expansion board, software cassette. No bugs. $280. Contact Gerald, 34 Margot St, Chadstone 3148. (03)277-4870 a.h.

FOR SALE: Sinclair ZX80 complete with manual and companion book plus 8K ROM, $350. G. O'Connor, 17 Roland Ave, Northmead 2152. Phone (02)639-8381.

SELL: 630K Micropolis quad density dual drives, S100 controller, software includes MDOS, ZASM, MBASIC, CPM, CBAS2, WORDSTAR. As new. $1450. Brian Lees (02)543-2285.

SELL: S100 RAM boards, Logos I 8K x 8 (4 off), $80 each; TCT 16K x 8 (1 off), $160. All fully burnt in and tested with the DGZ80. Paul, b.h. (03)615-4183, a.h. 543-5451.

SALE: Practically new Casio fx-502P LCD programmable calculator + FA-1 cassette interface, $140 ono. Mini-recorder to suit, $36 ono. R. Lim (08)298-5199. 35 Davenport Tce, Seaview Downs SA 5049.

CHIP8 — Programs and routines to share and swap. Offer of help to other beginners. Frank Rees, 27 King St, Boort Vic 3537.

MISCELLANEOUS

SELL: ICS, LM3065, UPD10 11A, FCL RE9AS, all $1 ea. LM556 75¢. Trimpots, 500k, 4k7, 1M, all 16¢ ea. Switch trimpot, 4M7, 30¢ ea. M. Sully, 61 Newman St, Niddrie Vic. 3042. (03)379-2879.

SELL: Arlunya colour bar generator mod PG31. SWE check CRT tester mod 300, $250 ono. Phone (08)254-6482.

SELL: TI-58C prog. calculator master and surveying modules, charger, no carry case, $110 ono. Warren Schaeche, 4/7 White Avenue, East Kew 3102.

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A CORRESPONDENT of our acquaintance has turned the rather dubious practice known as the er, um "... dirty telephone call ..." into a new art form with the aid of 'microprocessor technology'.

Being a lad of many activities and irregular employment, he found he was missing out on 'opportunities' for employment and dalliance alike because of the difficulty of contacting him. A telephone answering machine seemed like the answer. After some considerable market research and several 'field trials' he obtained a model marketed by a well-known Australian electronics importer/retailer. Advertised as employing the ubiquitous microprocessor technology and featuring the ability to insert numerous 'messages' of your own devising, he set about obtaining said machine and installing it.

Being of an imaginative bent, or just bent (who's to say? ... Ed.), he wanted to make use of the particular characteristics of the machine. The way it is arranged, each successive caller can receive a different message from the 'callee' as the cassette tape employed is preprogrammed with messages followed by a blank for the caller's message to be recorded. The first message or two were simple statements from our correspondent containing a 'straight' message about his whereabouts (... "out") and imploring the caller to leave a message after the beep.

Following the initial 'straight' message or two came a message from a 'friend', couched in terms designed to make the caller wonder (at the least!), if not to try again. Successive messages were recorded by a lady of our correspondent's acquaintance who is renowned for her 'enticing' telephone voice, each message becoming decidedly more risque than the previous one! What's more, the gap left for the caller's message became shorter and shorter – persistent callers getting a real treat! (Few left coherent messages after the fourth or fifth call.)

After having a little fun with this (particularly with wrong number callers) he hit upon the idea of changing the tape from time to time and keeping those which contained entertaining reactions from callers ... for replay as party entertainment!

Pun-ultimate?

When we closed the Dregs Pun Competition in the July issue we warned you about 'the last pun'. The prize (instant notoriety) goes to our Managing Editor, Collyn Rivers. Read on ... and groan three times at the end — if you understand it!

Elmo's Stratocaster needed repair. Having exhausted the USA's repair facilities he was finally directed to a specialist in Germany's Wittenberg.

Having spent several thousand dollars in return tickets for the guitar and himself, Elmo finally knocks on the repairer's door.

The repairer takes one look at Elmo's guitar and flatly rejects the job. When pressed for an explanation he says, "I thought it would have been obvious — I'm strictly a Martin Lutherist!"

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